OCTOBER 1958

# WIRE AND WIRE PRODUCTS

*Since*

**OUR HUNDREDTH ANNIVERSARY • 1856-1956**

**VAUGHN has developed for you**

***—in less than two years!***

*See Pages* 1204 A, B, C and D

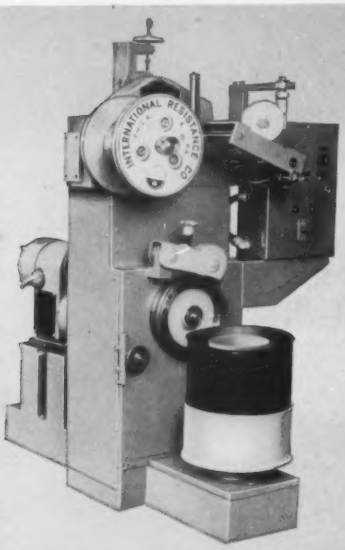
THE VAUGHN MACHINERY COMPANY • *Cuyahoga Falls, Ohio, U.S.A.*

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

# COULTER & McKENZIE

## CONSTANT TENSION DRAW-PAK EQUIPMENT

## FOR CONTINUOUS WIRE PACKING & DRAWING




- Combination drum or spool take-up and rewinder.
- Shown for single wire.
- Adjustable for tension, pitch and amplitude of traverse.
- 12" spool shown. 30 to 150 lb. drums.

### MODEL C-100 TAKE-UP

- Shown with single drive mounting to 16 wires .008" to .051"
- Enameling, annealing, galvanizing, tinning, etc.
- Containers 30 to 150 lbs.

Pat. No. 2,732,[illegible]0. Other U.S. and foreign patents pending.

### MODEL C-500 TAKE-UP

- Shown with tandem drive mounting 8 wires each side .020" to .250".
- Galvanizing, patenting, enameling, etc.
- Drum or adapter weights 200 to 1,000 lbs.

### MODEL 138-A DRAW BLOCK

- Single draft wires .016" to .375"
- "Draw-cast" die box shown gives adjustable positive cast control. Also available in other sizes.
- Process adapters to order — drums to 1,000 lbs.

ur inquiry specifying the application which is of interest you will result in prompt and courteous attention.

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☆ ☆

John ☆ Bruce

☆ Kent ☆

☆ Eric ☆ Ed ☆

☆ Earl ☆

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COMPOUNDS CO., INC.

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Telephones: 2131 - 2141

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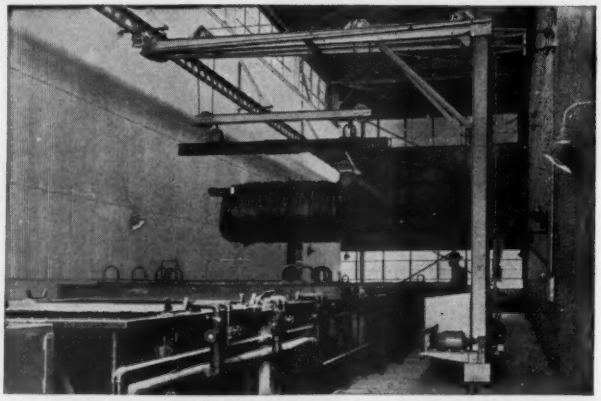
# MATERIALS HANDLING IN THE WIRE INDUSTRY

Many wire and wire products plants are enjoying the numerous advantages possible with Cleveland Tramrail. They are speeding production and lowering costs by using larger production units, eliminating rehandling and reducing machine "shut-down" time. They are using overhead space to save floor space. They are promoting safety. In many instances they are eliminating need of plant expansion by installing Cleveland Tramrail.



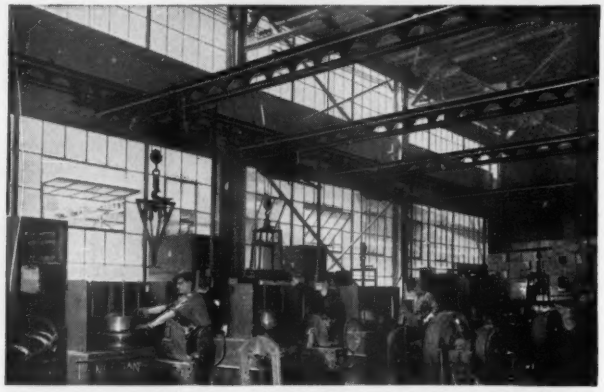
Cleveland Tramrail cleaning house gantry cranes boost production, cut costs sharply and greatly aid health and safety conditions.

## STANDARD ITEMS EASILY COMBINED TO HANDLE MATERIALS OF ANY KIND

Cleveland Tramrail raised-tread long-wear rail.

Cleveland Tramrail consists of standard items such as rail, switches, carriers, cranes, hoists, grabs, etc., which can be combined in a thousand-fold ways to serve nearly every materials handling requirement.

Cleveland Tramrail Archbeam in seven sizes for various loads and conditions.

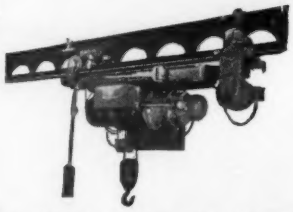


Providing each drawing block with an individual Cleveland Tramrail stripping crane speeds production and brings about sizable savings. Hernia injuries from heavy liftings are eliminated.

## 30,000 INSTALLATIONS

Hand propelled carrier built for long life and easy operation. Wheels have hardened tread and flange; bearings are double race type.

Backed by experience with 30,000 installations in industries of all types, Cleveland Tramrail representatives are in exceptionally good position to serve you. They will gladly advise, survey your plant, make layout or prepare quotation without obligation.



Motor-driven carrier with electric hoist. One of many types built by Cleveland Tramrail.

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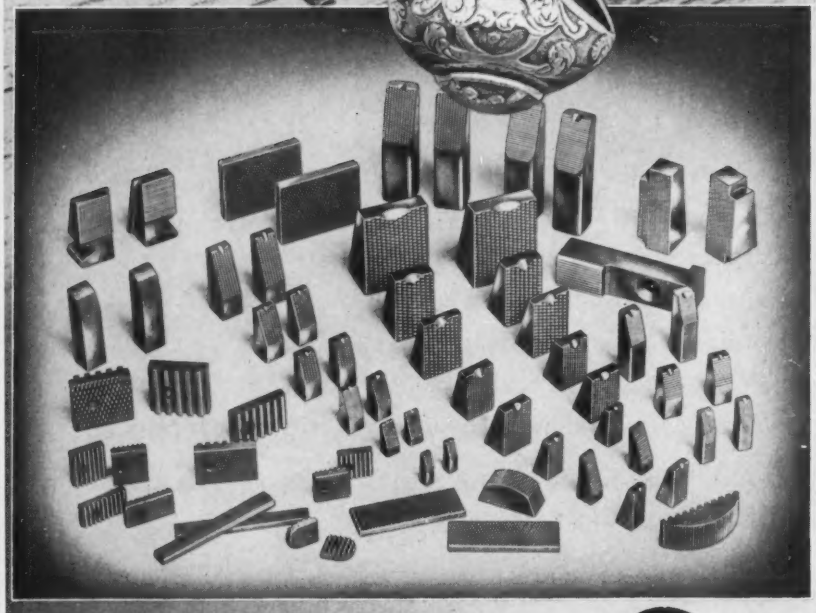
# CRAFTSMANSHIP

## ...an American Heritage!

Craftsmanship in this country was fostered by such expert artisans as the gunsmith, the woodcarver, the silversmith — and other workmen in basic arts and crafts who came from foreign lands to teach apprentices how to create and produce for quality — and not for price!

A fine example of the work of the early gunsmith is this old-time flintlock pocket pistol (probably made about 1750-60) which is artistically engraved with a floral design in high relief and elaborate scrollwork against a stippled background.

— from the gun collection at Old Sturbridge Village, Massachusetts.



Mindful of this heritage — Sjogren keeps in step with progress today by combining skilled manpower, modern machine power and advanced techniques to produce the highest quality wire mill tools and special machinery for *wire men who want the best!*

## Sjogren JAWS

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**used by wire men who want... the best!**

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Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 33 October, 1958 No. 10

Designated as Official Publication By The Wire Association


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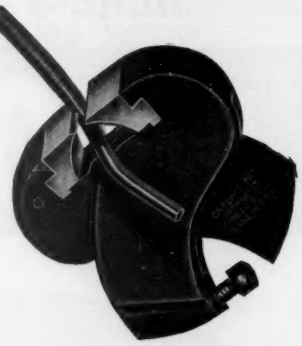

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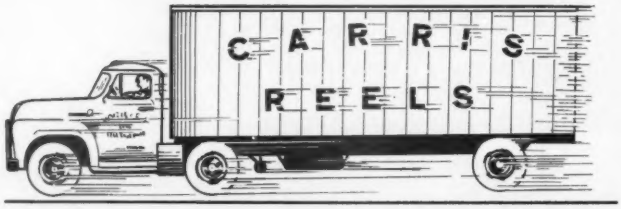


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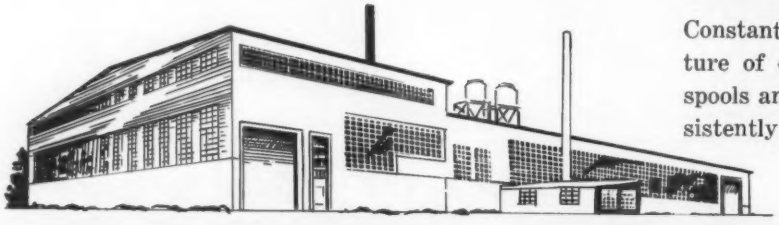

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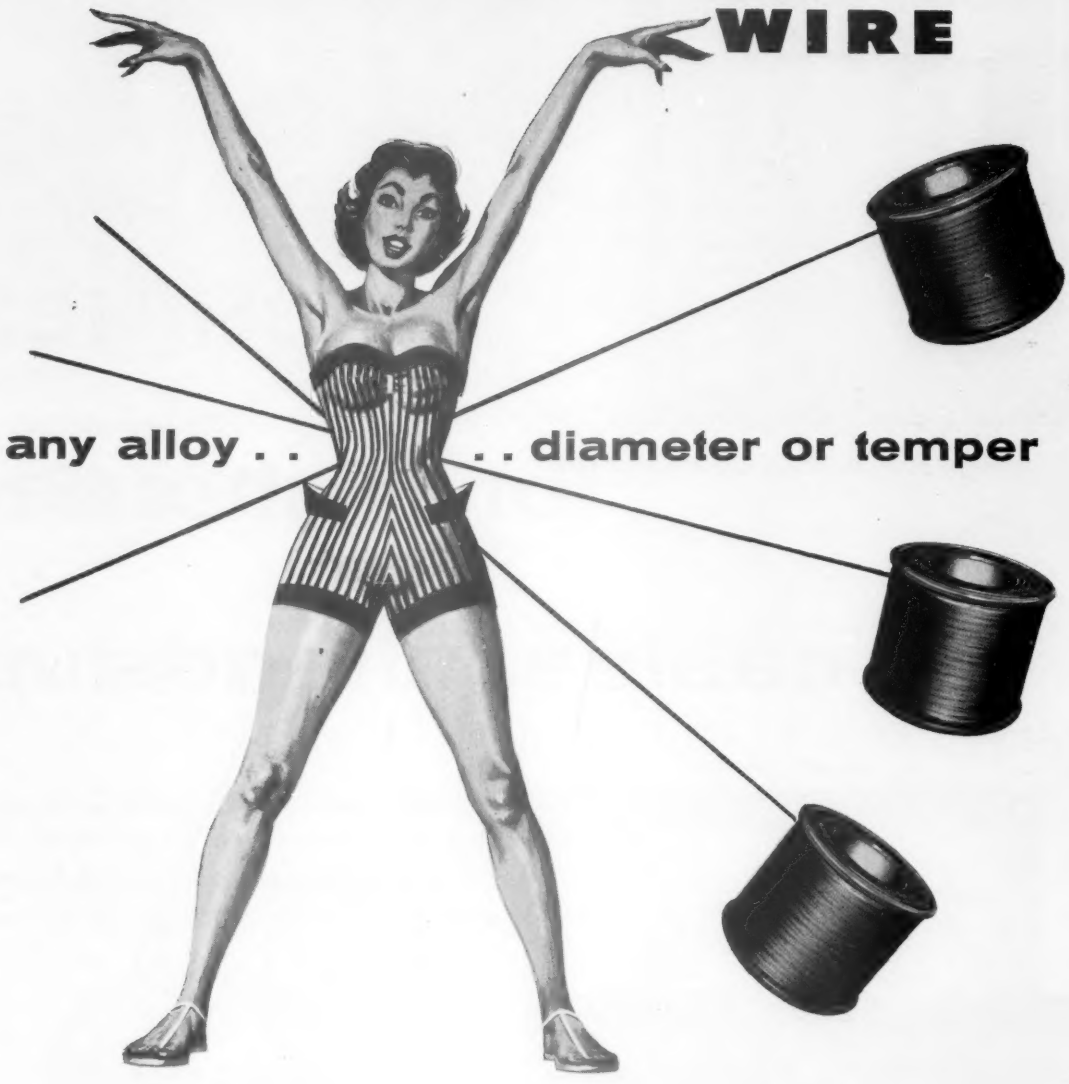


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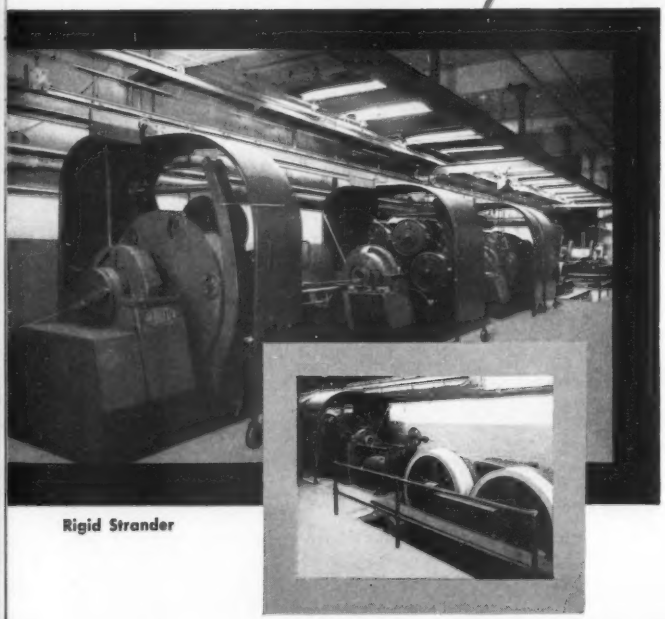
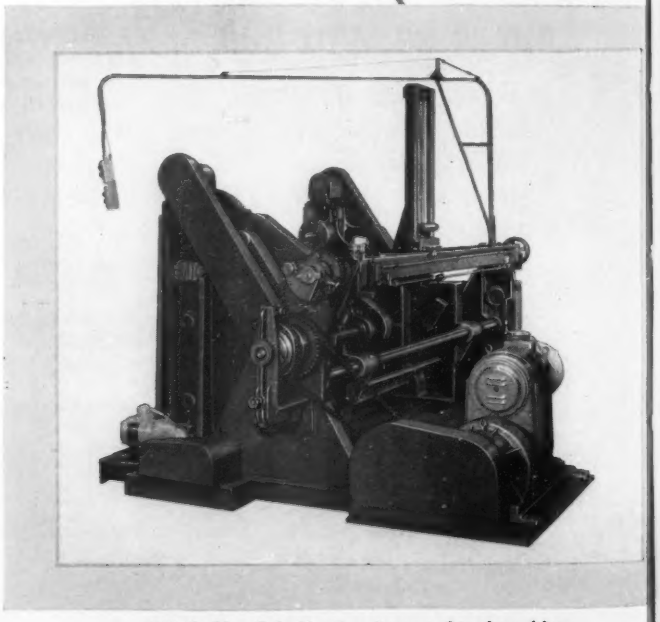
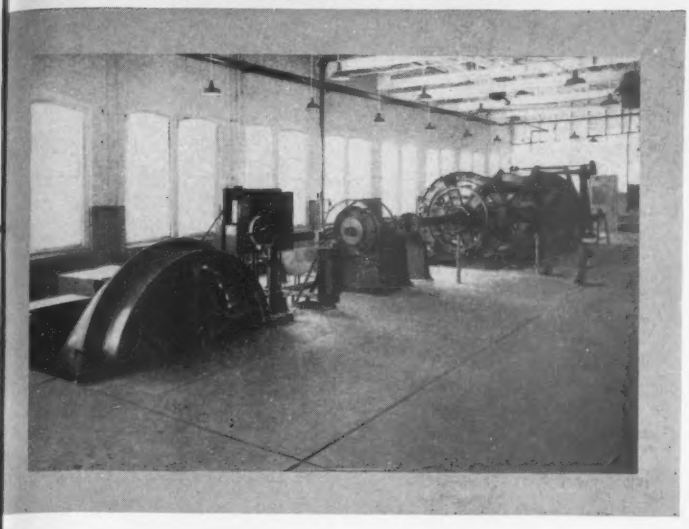


Rigid Strander

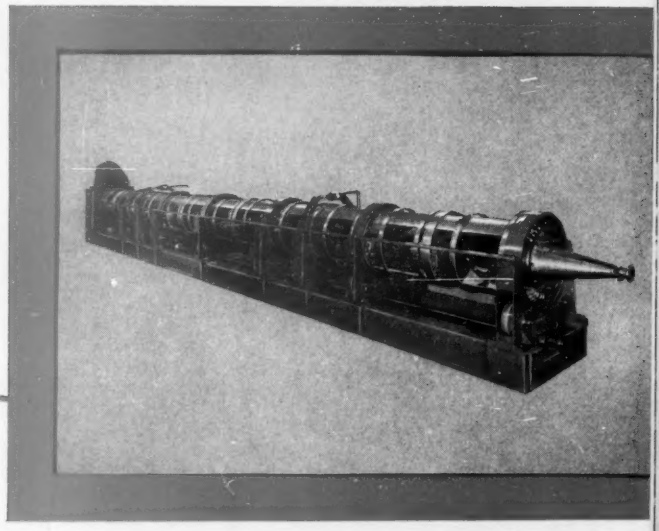


96" Shaftless Take-Up. Guard removed to show drive

7-strand Planetary Closer, for 60" x 48" reel



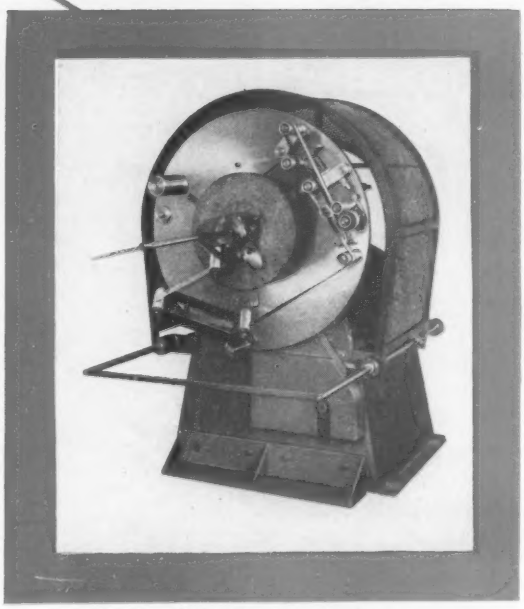
12-Wire Tube Strander



# production

# insulation

Eccentric Taping Head



Concentric Taping Head

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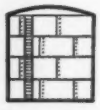
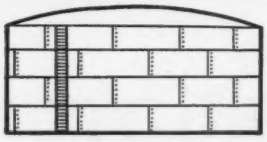
| **ACID SAVED** | 3 lb. per ton |  45,000 lb. per month |  540,000 lb. per year |
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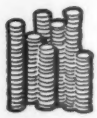
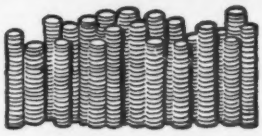
| **DOLLARS SAVED** | $.135 per ton |  $2,025.00 per month |  $24,300.00 per year |

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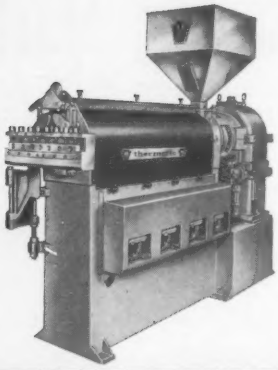
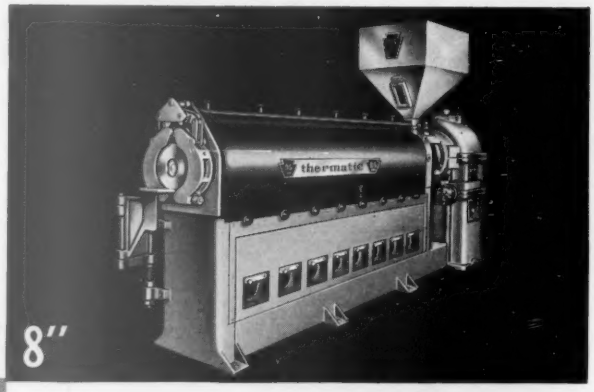
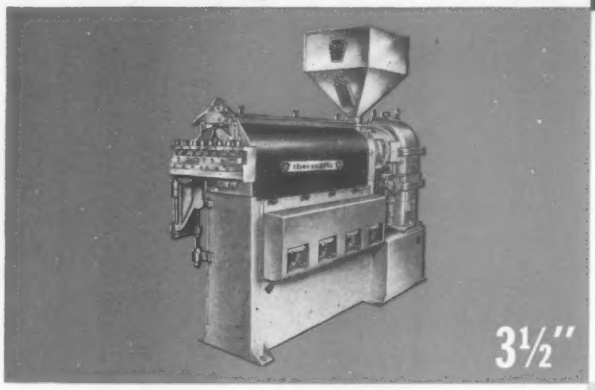


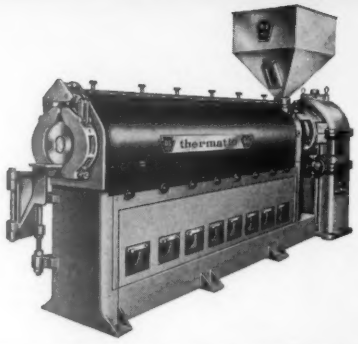
4½"



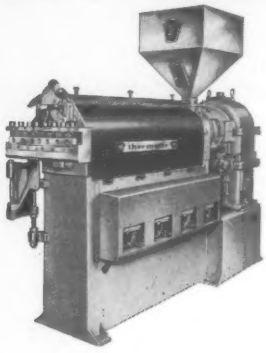
8"



3½"



6"



2½"

| | 2½" | 3½" | 4½" | 6" | 8" |
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# 3 *Reasons*

why

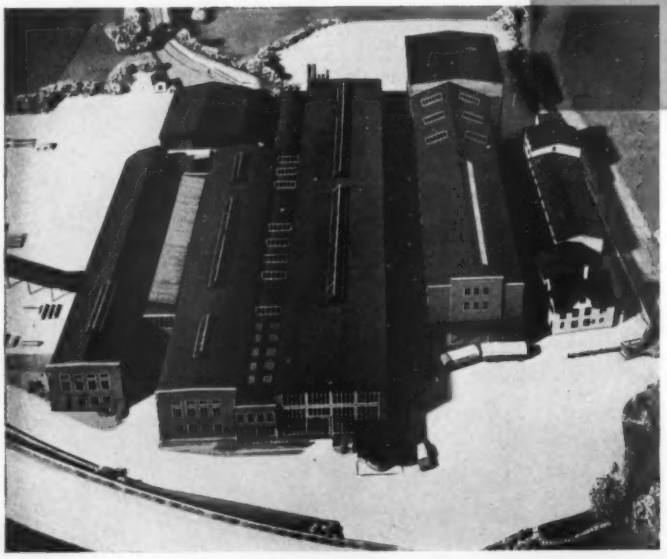
# HERBORN Wire Drawing Machines

## have found acceptance throughout the entire world

(1) modern assembly plants and equipment guarantee prime quality and workmanship.

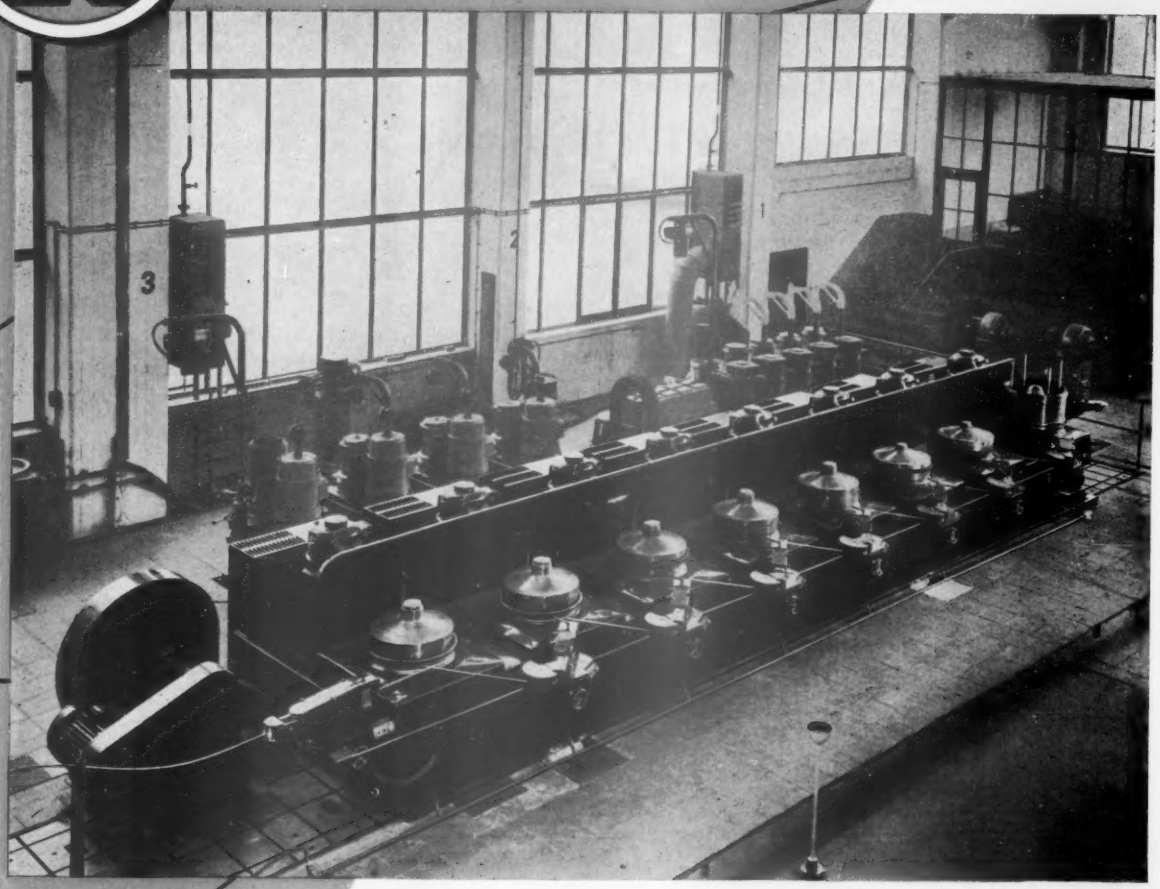
(2) operating experience for our machines is provided by our own wire mills.

(3) our comprehensive fabrication program can fill all requirements of the wire drawing industry.



Our Plant

# HERBORN



**HERBORN straight-through wire drawing machine**

model G Ia with 8 drafts

alternating current drive, with air- and water cooling system, for the drawing of medium and high carbon spring wire with starting size from 3/8" diameter.

Please send us your inquiries, we shall be glad to submit suggestions and proposals

**MASCHINENFABRIK HERBORN**
BERKENHOFF & DREBES A. G., HERBORN/GERMANY

**Sole Agent in USA:**
**Kurt Orban Co., Inc.**
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**Jersey City 2/N. J.**

**Sole Agent in Canada:**
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U.S.I.

Vol. II, No. 6

# POLYETHYLENE PROCESSING TIPS

## RESIN PROPERTIES THAT AFFECT STRESS-CRACK RESISTANCE OF POLYETHYLENE

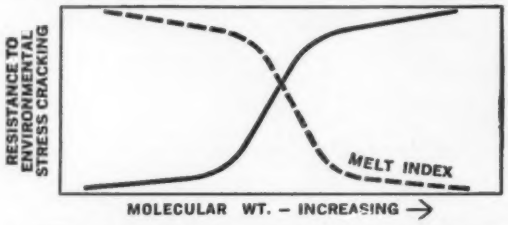
Environmental stress cracking is the term used to describe a certain type of material failure. With polyethylene this failure occurs when the plastic is under high local stress (either external or internal) and in contact with materials such as a soap, detergent, or solvent, which affects the polymer.

Resistance to stress cracking is especially important for applications such as electrical insulation, polyethylene pipe, housewares, and certain types of packages.

Two factors influence the resistance of a polyethylene part to environmental stress cracking: the resin used and the conditions used in fabricating the part.

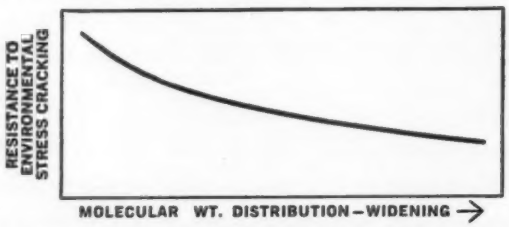
### Which resin to use:

Stress crack resistance is greater with a resin of ***higher molecular weight*** – that is, lower melt index.




Then why not use low melt index resins? Because production rates are lower. The processor must make a compromise between peak production rate and top stress-crack resistance and use a resin that will be satisfactory, if not ideal, in both respects.

***Molecular weight distribution*** of the polyethylene




resin is important too. Resins with a narrow molecular weight distribution (with fewer molecules much higher or lower than the average) have better stress crack resistance than those with wide molecular weight distribution (more of the larger and smaller molecules but the same average). The low molecular weight fraction is more susceptible to attack by environmental materials.

However, the flow properties of a polyethylene resin having a narrow molecular weight distribution and a given melt index are not as good as those of a polyethylene resin having a wide molecular weight distribution and the same melt index. Here again the processor must make a compromise between production rate and the properties he requires in the end product.

***Density of the resin*** will also have an effect on the resistance of that polyethylene resin to environmental stress cracking. The higher the density, the poorer resistance to environmental stress cracking. On the other hand, the more linear or more dense polyethylenes have enhanced flow properties and higher stiffness and tensile strength.

### There is no single answer to all problems

It is obvious from the preceding discussion that there is no simple solution to the selection of a resin for a particular end use. The resin must be carefully selected while giving proper consideration to the important end properties required in the fabricated article.

An answer to your particular problem can be found by obtaining a polyethylene resin from a manufacturer who can give you the balance of properties required – high or low melt index, narrow or wide molecular weight distribution, a range of densities. U.S.I. is one such supplier and their Technical Service Representatives stand ready to assist you in the selection of the proper Petrothene resin.

### Processing conditions affect stress crack resistance

Processing temperatures, cooling rates, and other processing conditions can have a marked effect on stress crack resistance, because of residual strains left in the fabricated article.

There isn't room to go into these in detail here but the next issue of "Tips" will discuss them more fully.

Meanwhile if you have a specific problem, call on U.S.I.'s Technical Service Engineers. They will be glad to work with you toward finding a solution.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.
*Branches in principal cities*

# *Memo to a Man of "Parts"*

The number of different parts made from Roebling High Carbon Specialties, Flat Wire and Spring Steel are close to countless.

Some things you can count on, though, are the consistent dimensional and mechanical uniformity you get with any Roebling High Carbon Specialty. They are the qualities that contribute to speeding *your* production and cutting *your* costs.

They are high qualities that make for high values. Next time you need flat wire or spring steel, specify Roebling. Write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

**ROEBLING**

*Branch Offices in Principal Cities*
*Subsidiary of The Colorado Fuel and Iron Corporation*

*Roebling... Your Product is Better for it*

# TALIDE DIE SAVES OVER $20,000 DRAWING AUTO BUMPER GUARDS

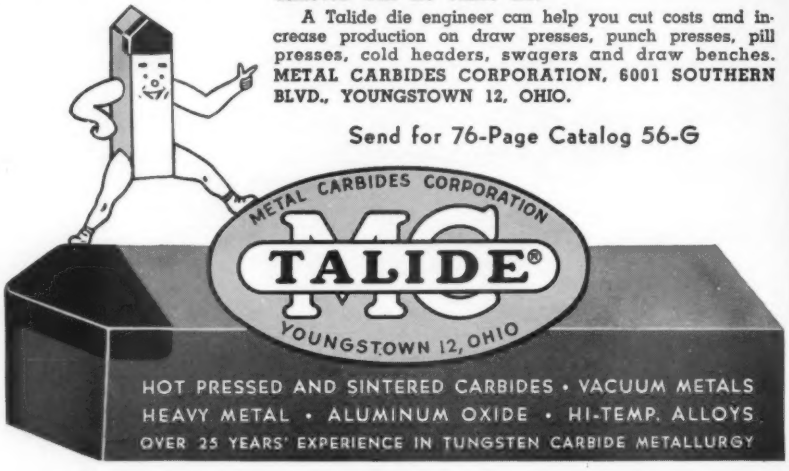
● Oakman Manufacturing Company, large Detroit stamping firm, found it difficult to deep draw steel bumper guards. Complex bends, up to 120 degrees, produced extra stress and strain on the $1800 chrome-plated drawing die.

It was necessary to stone the die surface every hour, and hand polish entire drawing surface after each day's run. The steel die had to be completely reworked and a new chrome-plated surface added after drawing 60,000 parts. Downtime for maintenance made it difficult to maintain production schedules. Maintenance costs soared.

A Grade C-80 Talide die ($2700) was installed 8 months ago. To date it has drawn over 800,000 guards with no wear in evidence. Downtime for die maintenance has been greatly reduced. A buffing operation (25c per piece), previously required, has been entirely eliminated because of the smoother, brighter, more durable finish achieved with the Talide die.

A Talide die engineer can help you cut costs and increase production on draw presses, punch presses, pill presses, cold headers, swagers and draw benches. **METAL CARBIDES CORPORATION, 6001 SOUTHERN BLVD., YOUNGSTOWN 12, OHIO.**

**Send for 76-Page Catalog 56-G**


METAL CARBIDES CORPORATION
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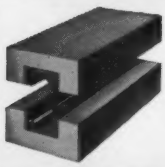
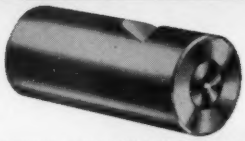
TALIDE®
YOUNGSTOWN 12, OHIO
HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY



**SWAGING DIES**

Leading Fountain Pen Manufacturer cold swages 33 times more stainless steel parts with TALIDE dies.

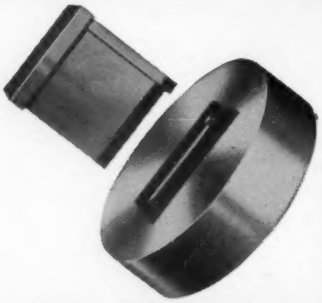


**HEADING AND EXTRUSION DIES**

Cold heading ¼" C-1008 rivets, TALIDE dies produced 11,200,000 pieces, other carbide dies only 3,500,000.

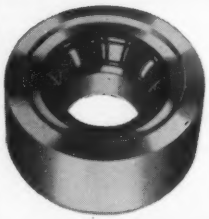
**CURLING ROLLERS**

TALIDE Curling Rolls last 65 times longer than steel rolls on beverage can forming operation.



**BLANKING AND FORMING DIES**

70 times more paper discs blanked out with TALIDE—over hard alloy die.

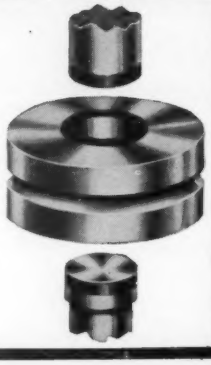


**SHEET METAL DIES**

137,000 hi-alloy steel pressure vessels drawn with TALIDE against only 7,900 with steel dies previously used.

**POWDERED METALLURGY DIES**

Compacting highly abrasive chemical powders, TALIDE pill dies last 4 months, steel dies wore out in 6 hours.



*Introducing the...*

BARTELL

**BARTELL**
**Seven Bay High Speed Strander**
Model 7B-58-15

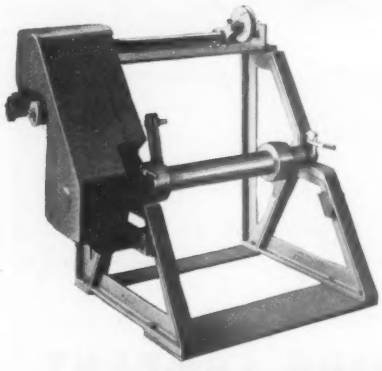
Also available in 6, 7, 12 & 18 bays. Spool Sizes: 8½" dia. with 6½" traverse.

Frames are constructed of hot rolled shapes and plates to form a rigid box structure—Barrel is extruded 6062T-6 aluminum—Smooth starts through slip clutch driven by 7½ H.P. motor—Operators control station at front of machine—Main power control center at drive end—Electronically controlled automatic stop energizes solenoid operated brakes in event of wire breakage—Spool cradles and associated parts are completely interchangeable from one machine to another—Tungsten carbide wire guides throughout—Lay from ¼ in. to 5 in. long.

- **CATERPILLAR CAPSTANS**
- **SINGLE & MULTIPLE HEAD RESPOOLERS**
- **WIRE STRANDERS**
- **TAKE-UP & PAY-OFF STANDS FOR PLATING EQUIPMENT**

BARTELL

**TAKE-UP**



This Take-Up is belt driven, the drive originating from a slip clutch located outside the capstan box. Electrically operated traverse adjustable from zero to maximum reel width. Accommodates reels up to 30" dia. Speed selector sheave adjusts lay on reel to suit diameter of finished strand.

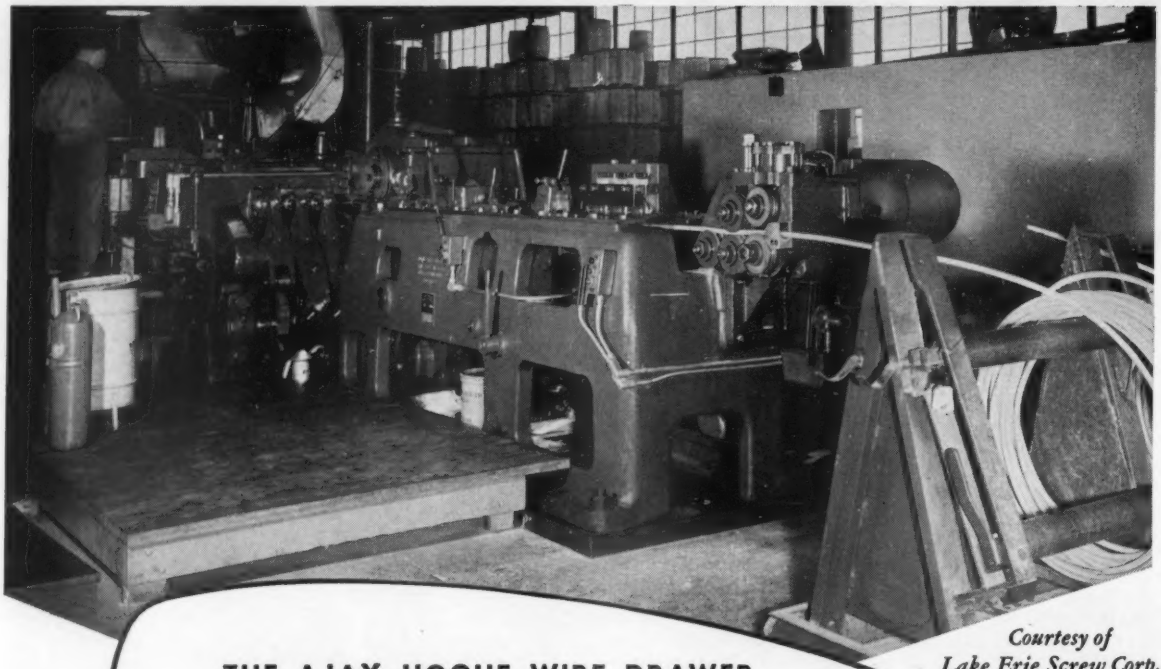
**WE ALSO DESIGN AND BUILD SPECIAL EQUIPMENT TO MEET SPECIFIED REQUIREMENTS.**

★ Designers
★ Manufacturers
★ Engineers
★ Consultants

BARTELL **MACHINE-TOOL CORP.**

YACHT CLUB ROAD — ROME, N. Y.

# DRAW STRAIGHT and ACCURATE WIRE FROM COILED RODS



*Courtesy of Lake Erie Screw Corp., Cleveland, Ohio*

**THE AJAX-HOGUE WIRE DRAWER** is a complete wire drawing unit custom designed to fit any make cold header or cold nut former. It cold draws wire in a straight line and coats wire from hot-rolled, pickled and limed rod as it feeds into the header.

A wire drawer attached to your header assures easier heading and improved products . . . The wire enters the header straight and gives straightness to the headed product. You are sure of uniformly accurate size wire from successive coils.

*Write for Bulletin 111-A*

## Ajax-Hogue Wire Drawers

AN ATTACHMENT FOR COLD HEADERS AND COLD NUT FORMERS

designed and built by

THE Ajax MANUFACTURING COMPANY

CLEVELAND 17, OHIO

110 S. DEARBORN ST., CHICAGO 3, ILLINOIS

W. P. WOOLDRIDGE CO. - BURLINGAME, CAL. - LOS ANGELES 22, CAL.

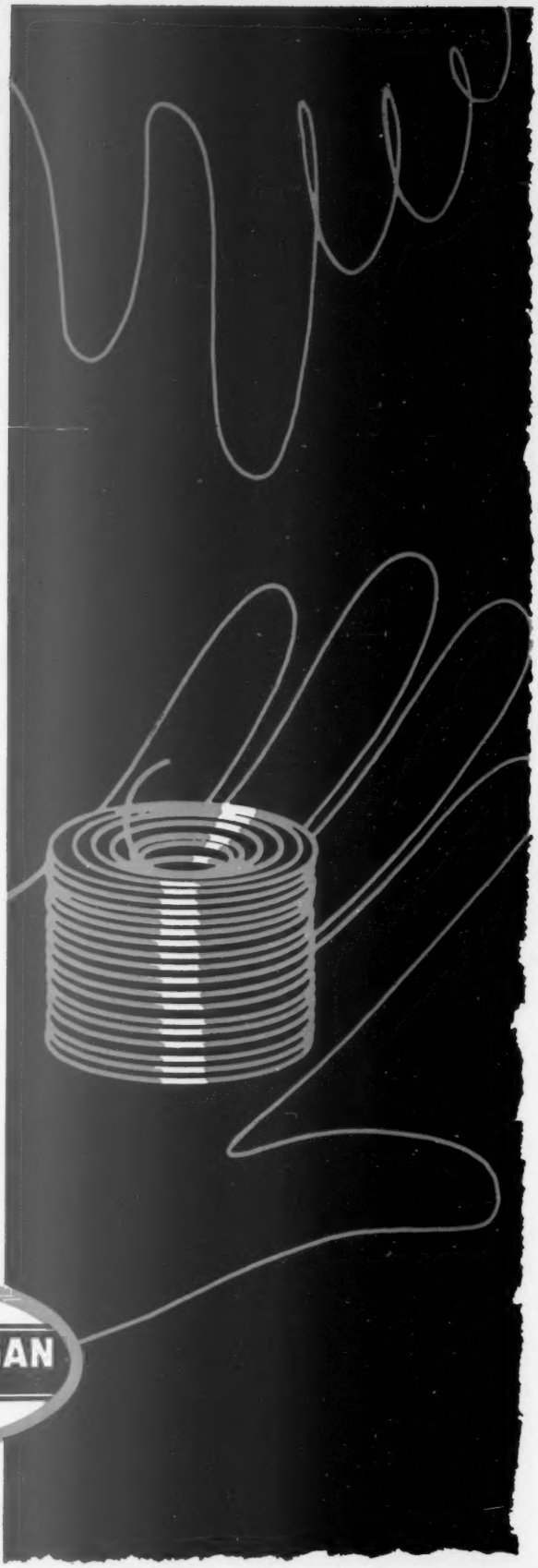
# FORMVAR... proved and preferred

More than 70% of all magnet wire used today is coated with phenolic modified Formvar enamel. Wire enamellers, motor manufacturers and motor users rely on Formvar in their processes and in their products. Formvar has proved its value and has established an unsurpassed record of dependability.

Formvar is the registered trademark for polyvinyl formal resins produced and sold only by Shawinigan Resins Corporation. When combined with a phenolic resin it becomes that tough, heat resistant wire enamel popularly known as Formvar enamel . . . the industry standard.

For wire insulations which permit trouble free service, lower maintenance and production costs, and greater efficiency, look to enamels based on Formvar. Shawinigan's exacting production controls and applications research keep Formvar a uniform and dependable ingredient for magnet wire enamels. Shawinigan Resins Corporation, Dept. 5310, Springfield 1, Mass.

SALES OFFICES: ATLANTA CHICAGO LOS ANGELES NEW YORK SAN FRANCISCO SPRINGFIELD



FORMVAR®

*polyvinyl formal by*

SHAWINIGAN RESINS

# LOW COST precision wire plating

## UNIFORM COATINGS MAINTAINED AT HIGH SPEEDS

## CONTINUOUS ELECTROPLATING EQUIPMENT

This low cost equipment performs with such ease and efficiency that it means real savings for you. Preset quality control insures perfection without depending on operators' skill. No toxic fumes, clean operation at low temperature, elimination of work hardening during processing, and many other features are the result of experience and sound engineering that go into the design of all Universal equipment.

We furnish complete installation . . .
For further information write to:

UNIVERSAL INDUSTRIAL EQUIPMENT CO.

SECAUCUS, NEW JERSEY

SOLE AGENT IN CANADA: E. V. LARSON CO., LTD., TORONTO, CANADA

U. S. PATENT # 2823180 AND FOREIGN PATENTS PENDING

# You'll get a better product with

# Pittsburgh PX-120 DIDP

Pittsburgh PX-120 (DiIso Decyl Phthalate) offers you a unique combination of properties which make it especially suitable for the economical production of vinyl-jacketed electrical wiring.

PX-120 possesses excellent low-volatility, a prime consideration in vinyl wire insulation, especially where higher-than-normal temperatures are encountered. For additional retention of elongation on aging, Pittsburgh PX-120 can be supplied with Bisphenol A added.

Whatever your vinyl product, you can count on PX-120 for good permanence, resistance to extraction, and low temperature properties . . . plus a low specific gravity that enables you to enjoy appreciable economies on a pound-volume production basis.

May we acquaint you further with this versatile plasticizer? Write for samples and technical data.

**PITTSBURGH *Job-Rated* PLASTICIZERS**

| | |
|---|---|
| PX-104 DiButyl Phthalate | PX-208 DiIsoOctyl Adipate |
| PX-108 DiIsoOctyl Phthalate | PX-212 n-Octyl, n-Decyl Adipate |
| PX-114 Decyl Butyl Phthalate | PX-218 IsoOctyl Decyl Adipate |
| PX-914 Butyl Octyl Phthalate | PX-220 DiIso Decyl Adipate |
| PX-118 IsoOctyl Decyl Phthalate | PX-238 DiOctyl Adipate |
| PX-120 DiIso Decyl Phthalate | PX-404 DiButyl Sebacate |
| PX-138 DiOctyl Phthalate | PX-438 DiOctyl Sebacate |
| PX-313 Modified Alkyl Phthalate | PX-800 Epoxy |
| PX-314 n-Octyl, n-Decyl Phthalate | PX-917 TriCresyl Phosphate |

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

# TERKELSEN'S WRAPPING MACHINE

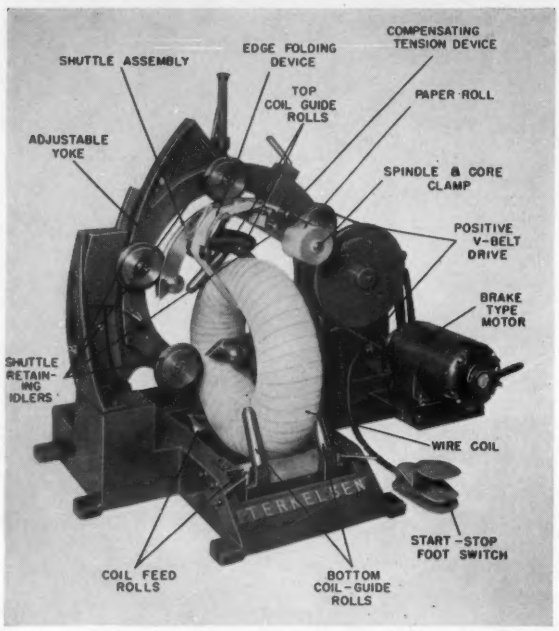
## *Designed to Wrap a Wide Range of Coils*

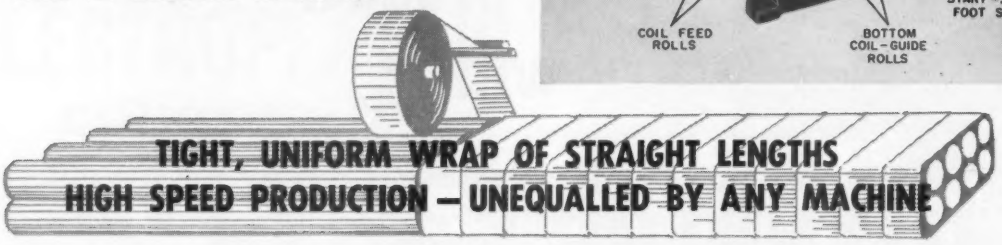
### MODEL 4-57

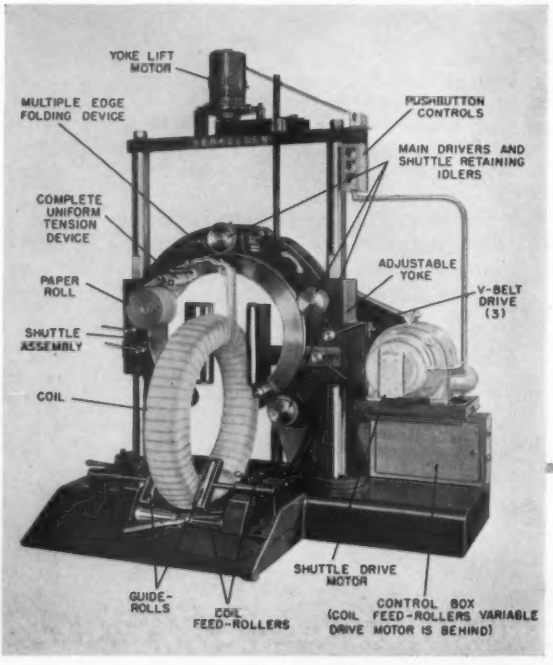
Terkelsen's newest wrapping machine wraps wire coils 17″ to 30″ outside diameter, minimum inside diameter of 10″, and with a cross-sectional diameter of up to 10″. New Model 4-57 features:

- **POSITIVE V-BELT DRIVE**
- **BALL BEARINGS THROUGHOUT**
- **START-STOP FOOT SWITCH**
- **COMPENSATING TENSION DEVICE**
- **EDGE FOLDING DEVICE**

Larger coil capacities available on order. Write for additional information.




### MODEL 4-B

Model 4-B has been designed to wrap a wide range of coils from 30″ to 50″ outside diameter with a cross-sectional diameter of up to 15″. Model 4-B features:

- **PUSH BUTTON CONTROL** *rotates coil in either direction.*
- **VARIABLE SPEED FEED ROLL DRIVE** *to obtain any desired overlap.*
- **POSITIVE V-BELT DRIVE** *from brake motor.*

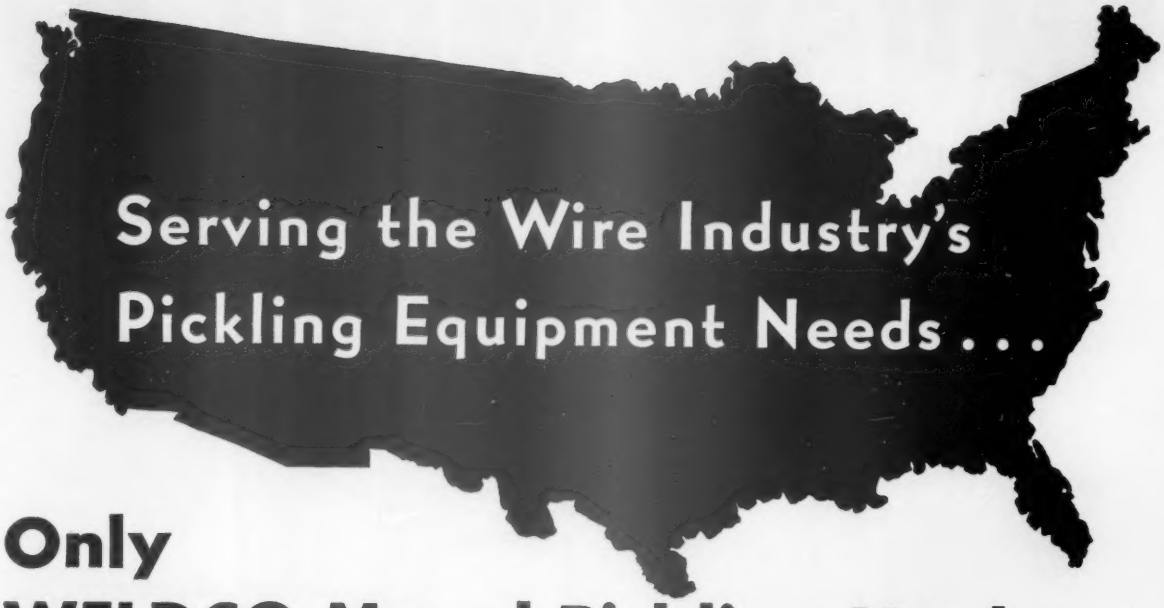
For additional information on coil or straight length wrapping machines, write to:

**TERKELSEN** *Machine Company*

**Terkelsen Building — 326 A Street Boston 10, Massachusetts**

*World's Largest Manufacturer of Spiral Wrapping Machines*

Member WAS




# Only WELDCO Monel Pickling Hooks Have Such Universal Acceptance!

**OTHER WELDCO PICKLING EQUIPMENT**

Mechanical Picklers,
Crates, Baskets,
Racks, Chain,
Steam Jets,
and Accessories

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American Steel & Wire Company - - - Donora, Pa.
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Bethlehem Steel Corporation - - Sparrows Point, Md.
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Electric Auto-Lite Company - - - - - Port Huron, Mich.
Indiana Steel & Wire Company - - - - - Muncie, Ind.
Johnson Steel & Wire Co. - - - - - - Worcester, Mass.
Jones & Laughlin Steel Corporation - - Aliquippa, Pa.
Keystone Steel & Wire Company - - - - - Peoria, Ill.
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Pittsburgh Steel Company - - - - - - - Monessen, Pa.
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**THE YOUNGSTOWN WELDING & ENGINEERING COMPANY**
3724 OAKWOOD AVENUE · · YOUNGSTOWN 9, OHIO

# NOW CF&I WIRE . . .

## clean . . . convenient . . . compact . . . cuts costs

This new, revolutionary method of packaging keeps CF&I Wire free of rust and dust from the last pass on the drawing frame, through shipping and storage, until the sealed fibre drum is opened at your wireforming machines.

Each 600-lb. capacity fibre drum holds from five to eighteen miles of CF&I wire in *one continuous length.* It provides these cost saving advantages: • **Increased production (fewer set-ups)** • **Wire will not snag or kink** **Simplified storage (stack them)** • **Easier inventory control (count them)** • **Can be palletized for easy handling** • **Less scrap loss (no coil ends).**

Whatever your packaging requirements, or whatever your specifications for steel wire may be, check with CF&I. Our newly modernized and enlarged plants can provide fast delivery on high or low carbon steel wire . . . round, flat or shaped . . . in a wide variety of sizes, tempers, grades and finishes . . . in small quantities, carload or mixed carload lots.

**WHEN YOU NEED WIRE . . . MAKE**

# IN FIBRE DRUMS

*Here is a partial list of the many types of carbon steel wire manufactured by CF&I:*

### GRADES

low carbon
medium high carbon
high carbon
  round
  square
  flat
  shaped

### FINISHES

bright dry drawn or lime bright
bright grease drawn
cadmium coated
coppered
extra clean smooth bright
galvanized
liquor
white liquor
tinned

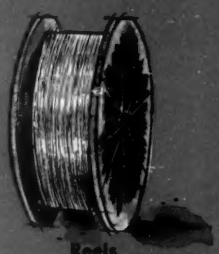
### STANDARD TYPES (partial list)

aircraft cord
bee
bobbin ring
bobby pin
bookbinder
broom
brush
casing
clip
concrete reinforcing
cotter pin
curtain spring
die spring
fine & weaving
fuse
Gamma spring
garment hanger
glass netting
hair pin
hat
hose, reinforcement
hose, mechanical
hose, vacuum
lock spring
lockwasher
manufacturers' drawn
mattress
merchant
nail
oil tempered
picker tooth
picture cord
pin ticket
regulator
rope
safety pin
screen
shaft, flexible
Signal Corps
snake fishing
spiral binding
spring
stapling
staple
stone
tie
twisted & laid
upholstery
valve spring
weaving
welding
Wissco Iron

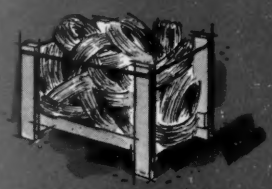
**Other CF&I standard packaging methods**

Steel-strapped coils
(200- 2000 lbs.)

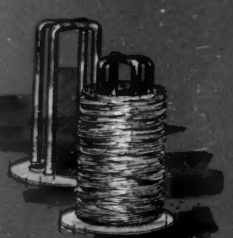
Non-returnable spiders
(500-700 lbs. capacity)



Reels
(500-800 lbs. capacity)



Steel-strapped
wooden rack



Returnable spiders
(2000-4000 lbs. capacity)

## CF&I-WICKWIRE WIRE

**THE COLORADO FUEL & IRON CORPORATION**

**THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise • Butte Denver • El Paso • Ft. Worth • Houston • Kansas City • Lincoln • Oklahoma City • Phoenix • Pueblo Salt Lake City • Wichita • **PACIFIC COAST DIVISION**—Los Angeles • Oakland • Portland • San Francisco San Leandro • Seattle • Spokane • **WICKWIRE SPENCER STEEL DIVISION**—Atlanta • Boston • Buffalo Chicago • Detroit • New Orleans • New York • Philadelphia • **CF&I OFFICES IN CANADA:** Montreal Toronto • **CANADIAN REPRESENTATIVES AT:** Calgary • Edmonton • Vancouver • Winnipeg

5933

**CF&I YOUR SOURCE OF SUPPLY**

WATERBURY FARREL
FOUNDED 1851

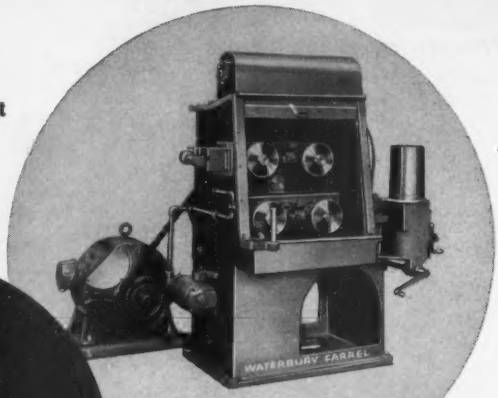
# Custom-Engineered Upright Cone *Wire Drawing Machines*

★ **In 4 Sizes**

★ **With Drive, String-Up and Packaging Equipment To Fit *Your* Specific Requirements**

★ **And Precision, Quality Construction Throughout**

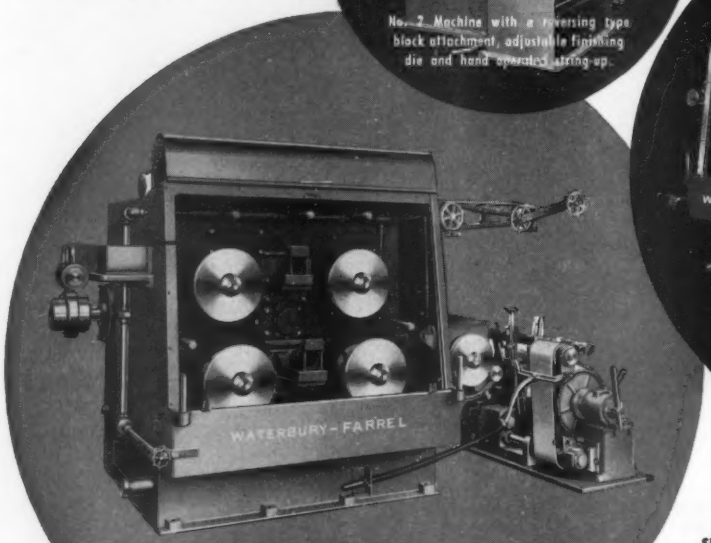
**Here are four examples of Waterbury Farrel's long-proven ability to custom-engineer wire drawing machines for specific applications. The machine *you* need may call for another variation in design. For further information on the size and type of upright cone machine fitted to *your* exact requirements, contact Waterbury Farrel, today.**




No. 1 Machine with a reversing type block attachment.

No. 2 Machine with a reversing type block attachment, adjustable finishing die and hand operated string-up.

No. 3 Machine with a floor spooler.



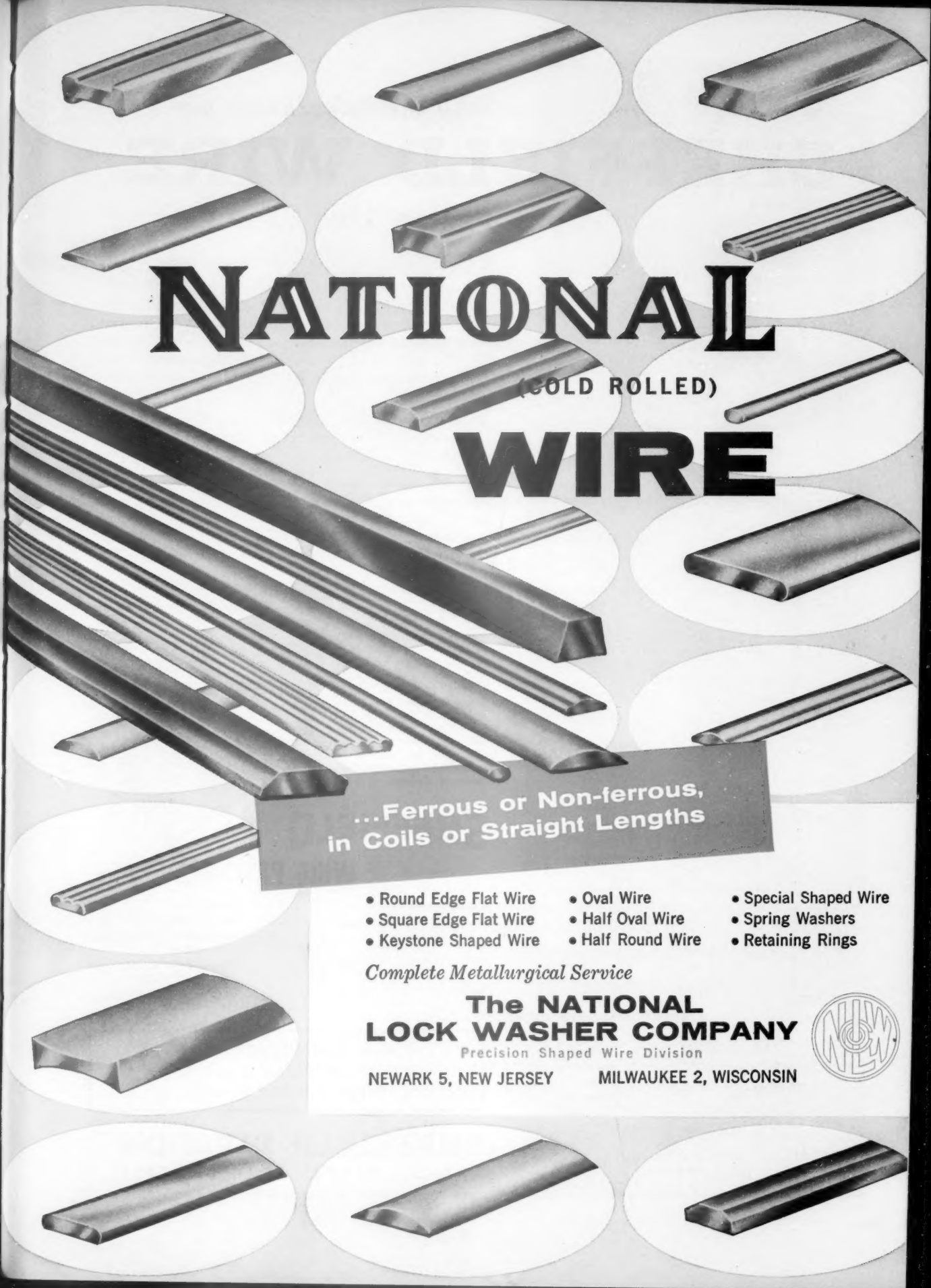

No. 4 Machine equipped with a cradle type floor spooler.

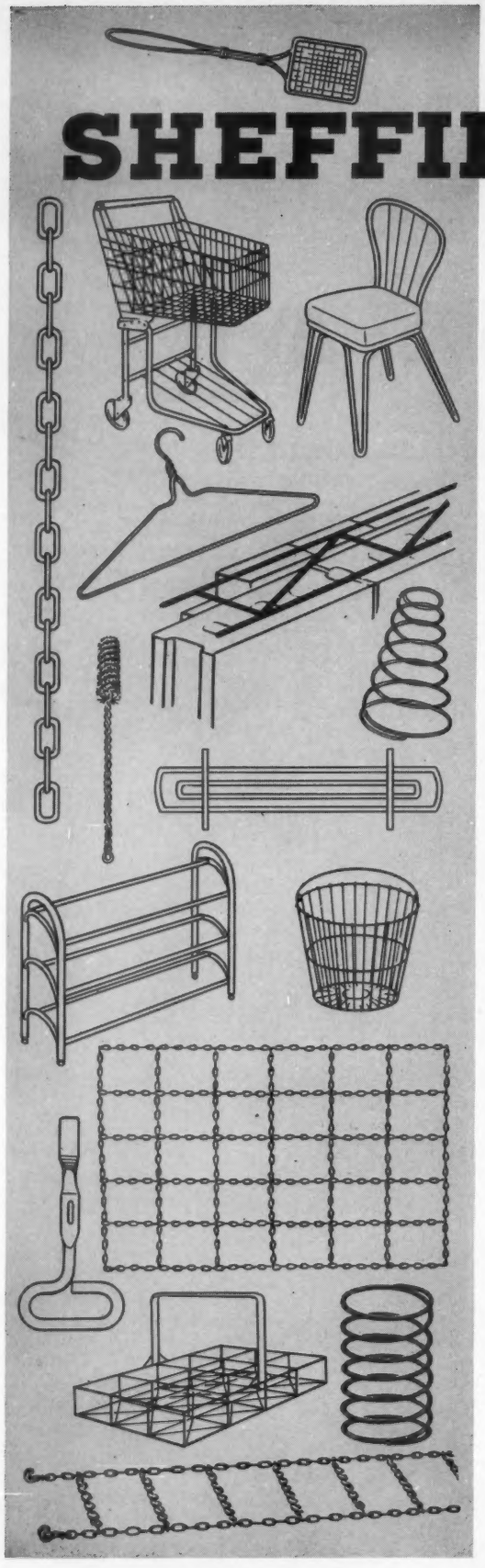
## SPECIFICATIONS

| Size of Machine | No. 1 | No. 2 | No. 3 | No. 4 |
|---|---|---|---|---|
| Max. No. of Dies | 16 | 14 | 12 | 13 |
| Max. Starting Size B & S | #14 | #8 | #4 | ¼ |
| Finishing Sizes, B & S | #26 to #42 | #20 to #34 | #14 to #26 | #12 to #18 |

WF-26

WATERBURY FARREL
FOUNDRY & MACHINE CO.
Waterbury, Conn. U. S. A.
*Sales Offices: Chicago • Cleveland • Millburn, N. J.*


NATIONAL
(COLD ROLLED)
WIRE
...Ferrous or Non-ferrous,
in Coils or Straight Lengths
• Round Edge Flat Wire
• Square Edge Flat Wire
• Keystone Shaped Wire
• Oval Wire
• Half Oval Wire
• Half Round Wire
• Special Shaped Wire
• Spring Washers
• Retaining Rings
Complete Metallurgical Service
The NATIONAL
LOCK WASHER COMPANY
Precision Shaped Wire Division
NEWARK 5, NEW JERSEY
MILWAUKEE 2, WISCONSIN
NLW



*Why manufacturers use*

# SHEFFIELD WIRE

## *in more than 2,000 quality products*

Manufacturers and fabricators depend on Sheffield Wire for unvarying quality and accuracy in meeting their wire specifications. They are sure of getting the RIGHT wire—and getting it fast—because of Sheffield's advanced quality controls and strategic plant locations.

We're old hands at helping customers solve wire problems—with results that speed production, cut costs and improve products.

Let our metallurgists and wire specialists analyze your wire uses. We'll not only come up with the right wire for you, but also may be able to recommend more economical ordering units. This service is yours for the asking. Just call your nearest Sheffield office.

**SHEFFIELD KONE PAK***

gives you in one continuous spool the equivalent of 2 to 40 ordinary coils of wire. It gives longer continuous runs, less down time, and can cut scrap losses as much as 90%. The Kone Pak is mounted on a disposable wooden pallet, and can be packed in streamlined cardboard container if desired.

## SHEFFIELD ARMCO WIRE PRODUCTS

**Coiled Wire**

**Annealed**—#20 (.035" ga.) through 1"

**Galvanized**—#20 (.035" ga.) through #4 (.225" ga.)

**Bright**—#20 (.035" ga.) through 1"

**Straightened and Cut Wire**

**Annealed**—#20 (.035" ga.) through ¾"

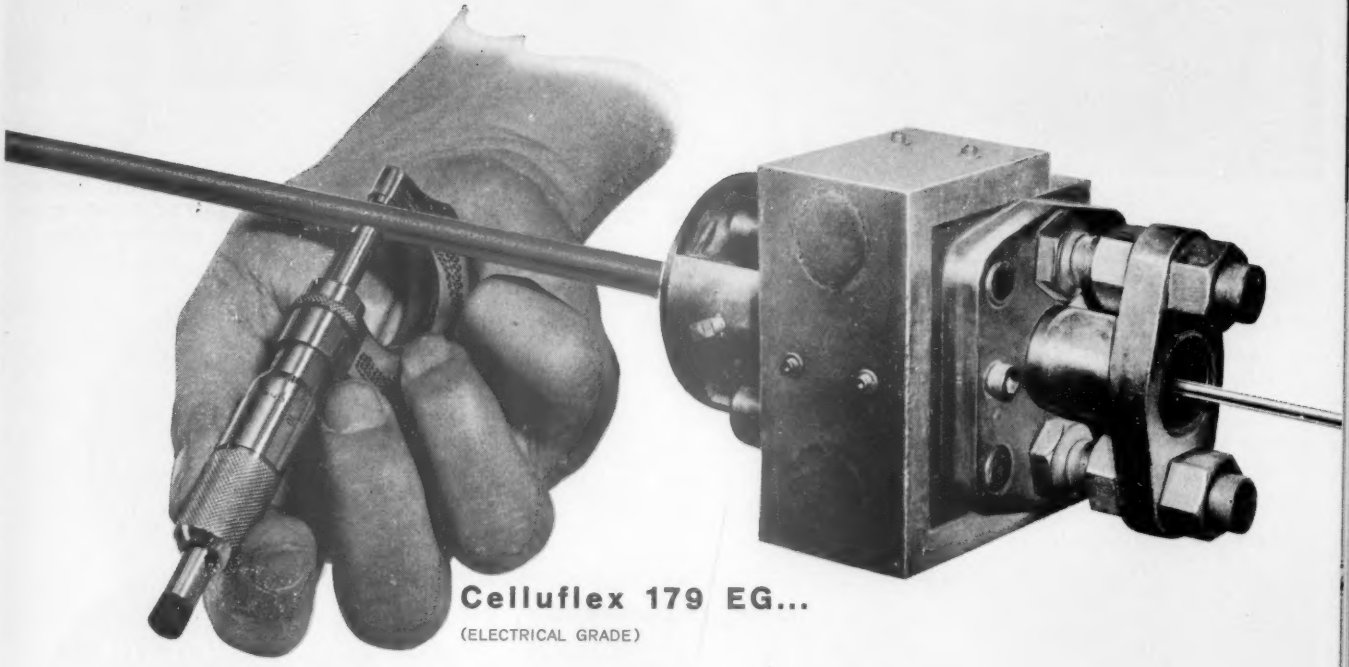
**Galvanized**—#20 (.035" ga.) through #4 (.225" ga.)

**Bright**—#16 (.0625" ga.) through ¾"

* Patent Pending

**New ALUMINIZED WIRE**
16 ga. (.0625") through 6 ga. (.192")
**WRITE FOR FREE SAMPLE**

## SHEFFIELD DIVISION
ARMCO STEEL CORPORATION
SHEFFIELD PLANTS: HOUSTON • KANSAS CITY • TULSA



## Celluflex 179 EG...

(ELECTRICAL GRADE)

## selected for dependability and ease of processing

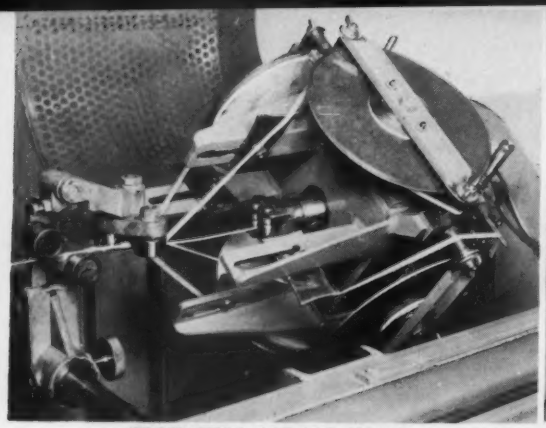
... add excellent volume resistivity, low volatility, fire resistance, excellent solvating action, oil and water resistance . . . result: a tricresyl phosphate specially developed for the wire and cable industry for application in vinyl coverings.

Celanese is an expanding source for plasticizers for many jobs. Shipments from convenient distribution points are ready to meet tight schedules. Write Celanese Corporation of America, Dept. 590-J, Chemical Division, 180 Madison Avenue, New York 16, N. Y., for complete information. Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.

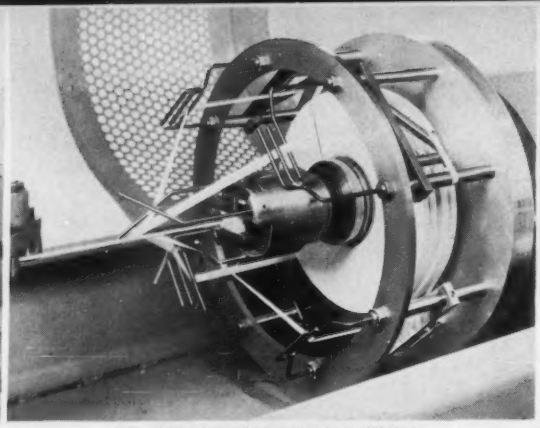
Celanese® Celluflex® Lindol®

**Celluflex 179 EG . . . a Celanese CHEMICALS plasticizer**

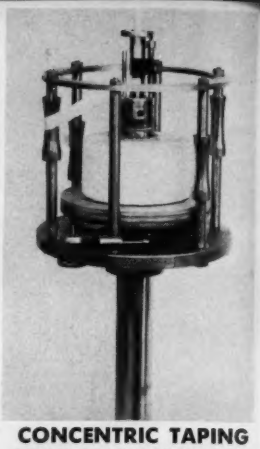
Call Celanese for: Tris-beta Chlorethyl Phosphate . . . *CELLUFLEX CEF;* Epoxy Plasticizers . . . *CELLUFLEX 21 and 23;* Four grades of flame-retardant Tricresyl Phosphate . . . *LINDOL (low color) . . . CELLUFLEX 179A (low specific gravity) . . . CELLUFLEX 179C (general purpose grade) . . . CELLUFLEX 179EG (electrical grade);* Cresyl Diphenyl Phosphate . . . *CELLUFLEX 112;* Dibutyl Phthalate . . . *CELLUFLEX DBP;* Dioctyl Phthalate . . . *CELLUFLEX DOP;* Triphenyl Phosphate . . . *CELLUFLEX TPP.*



ECCENTRIC TAPING HEAD
NO. 889 (2, 3 & 4 TAPES)

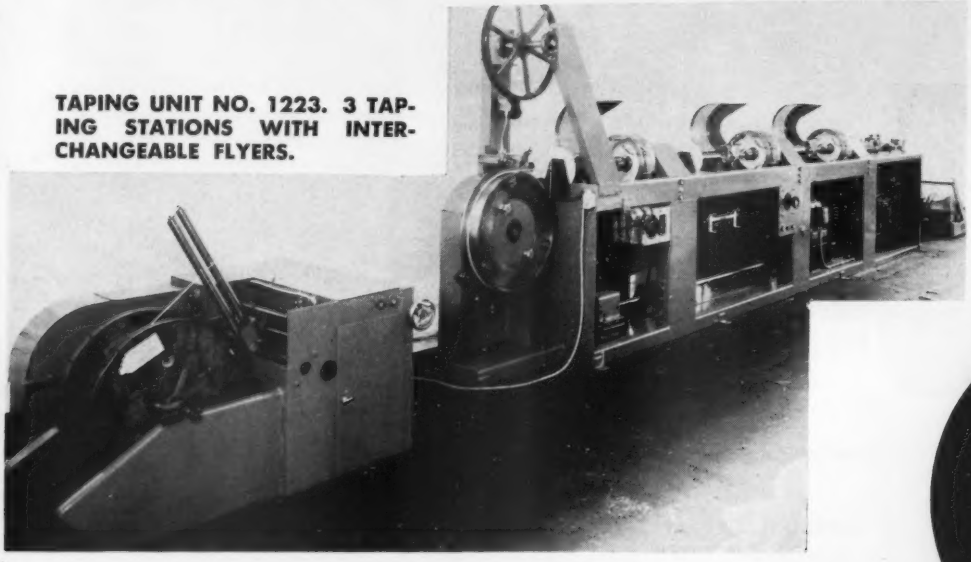


CONCENTRIC TAPING HEAD
NO. 1231 (1, 2, 3 or 4 TAPES)

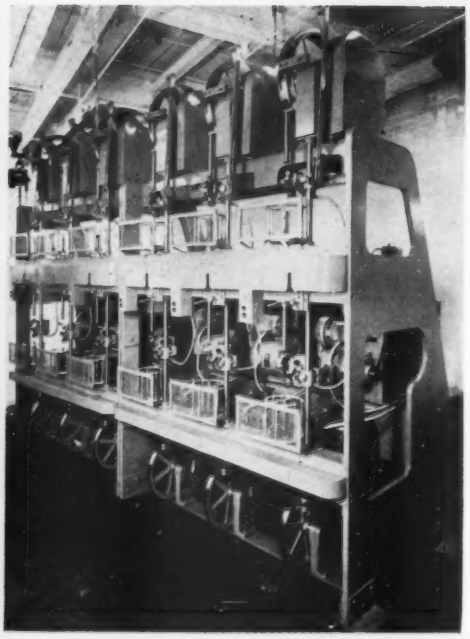


CONCENTRIC TAPING HEAD FOR UNIVERSAL WOUND COPS
NO. 1147.

TAPING UNIT NO. 1223. 3 TAPING STATIONS WITH INTERCHANGEABLE FLYERS.

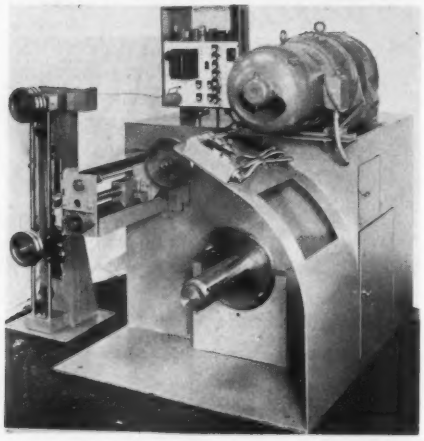


EST 1855 AIMCO INC 1915
"American" INSULATING MACHINERY COMPANY
REG. U.S. PAT. OFF.
FAIRHILL AND HUNTINGDON STREETS
PHILADELPHIA 33 PENNSYLVANIA U.S.A.
MANUFACTURERS OF WIRE INSULATING MACHINERY AND ALLIED EQUIPMENT, MACHINERY MFG. TO CUSTOMERS SPECIFICATIONS.

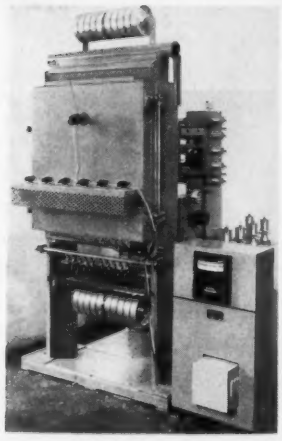


DOUBLE TAPING MACHINE NO. 1107. APPLIES 2 TAPES TO EACH OF 6 ROUND OR FLAT WIRES.

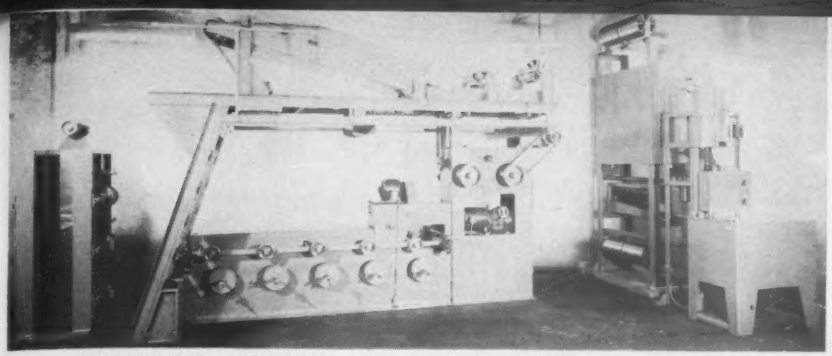
HEAVY TAKE-UP NO. 1234, BEHIND WIRE DRAWING AND TINNING.



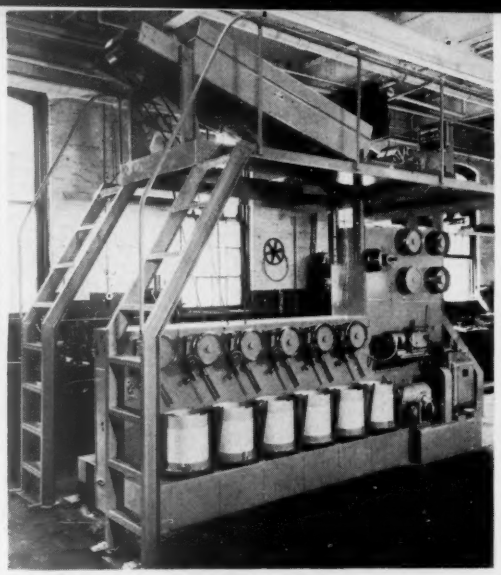
M-10 ENAMELING MACHINE NO. 1220 FOR FINE WIRES, 36 AND FINER.



**AMERICAN INSULATING MACHINERY COMPANY**
FAIRHILL AND HUNTINGDON STREETS PHILADELPHIA 33, PENNSYLVANIA, U.S.A.



ENAMELING MACHINE AND PRE-ANNEALER NO. 988 FOR REEL TAKE-UP. B&S GAUGE 20 TO 30.



NO. 1237. SAME AS ABOVE FOR BARRELL TAKE-UP, B&S GAUGE 20 TO 30.

EST 1855 AIMCO INC 1915

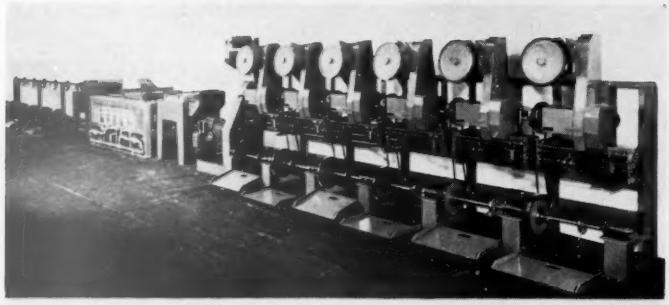
"American" INSULATING MACHINERY COMPANY

TRADE MARK

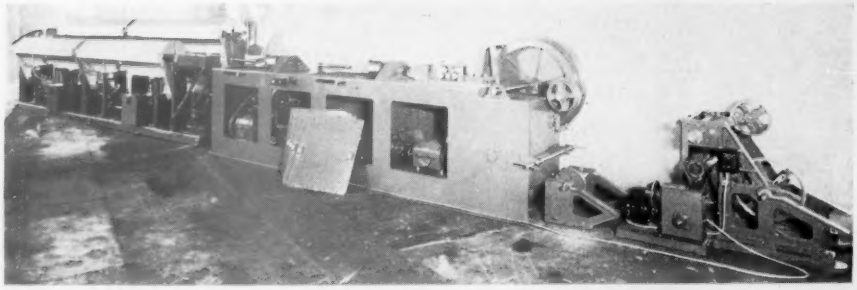
FAIRHILL AND HUNTINGDON STREETS

PHILADELPHIA 33 PENNSYLVANIA U.S.A.

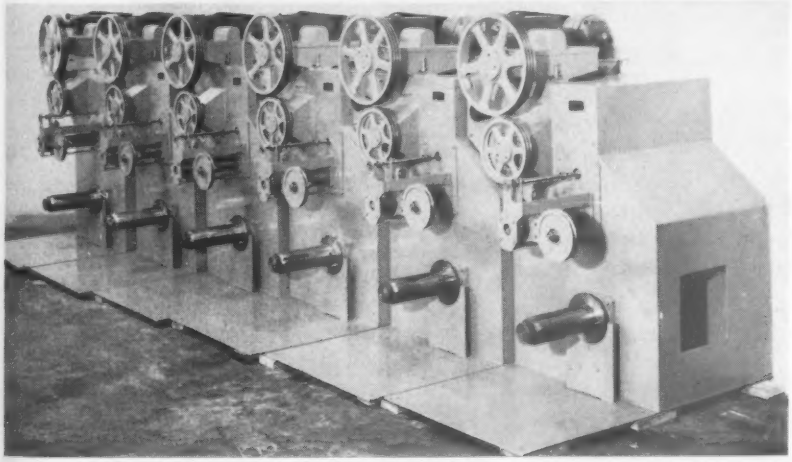
MANUFACTURERS OF WIRE INSULATING MACHINERY AND ALLIED EQUIPMENT. MACHINERY MFG. TO CUSTOMERS SPECIFICATIONS.



HEAVY WIRE TINNING OUTFIT NO. 1010 WITH GAS HEATED TINNING TANK AND AUTOMATIC HEAT CONTROL.



GLASS INSULATION WIRE COVERING MACHINE NO. 805, WITH ELECTRIC HEATED VARNISH BAKING OVEN.



MULTIPLE WIRE TAKE-UP NO. 1049, 6 INDIVIDUAL UNITS, EACH REEL-ARBOR TORQUE MOTOR DRIVEN. FOR USE IN WIRE TINNING OUTFITS, ETC.

**AMERICAN INSULATING MACHINERY COMPANY**

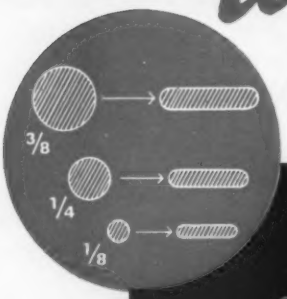
FAIRHILL AND HUNTINGDON STREETS PHILADELPHIA 33, PENNSYLVANIA, U.S.A.

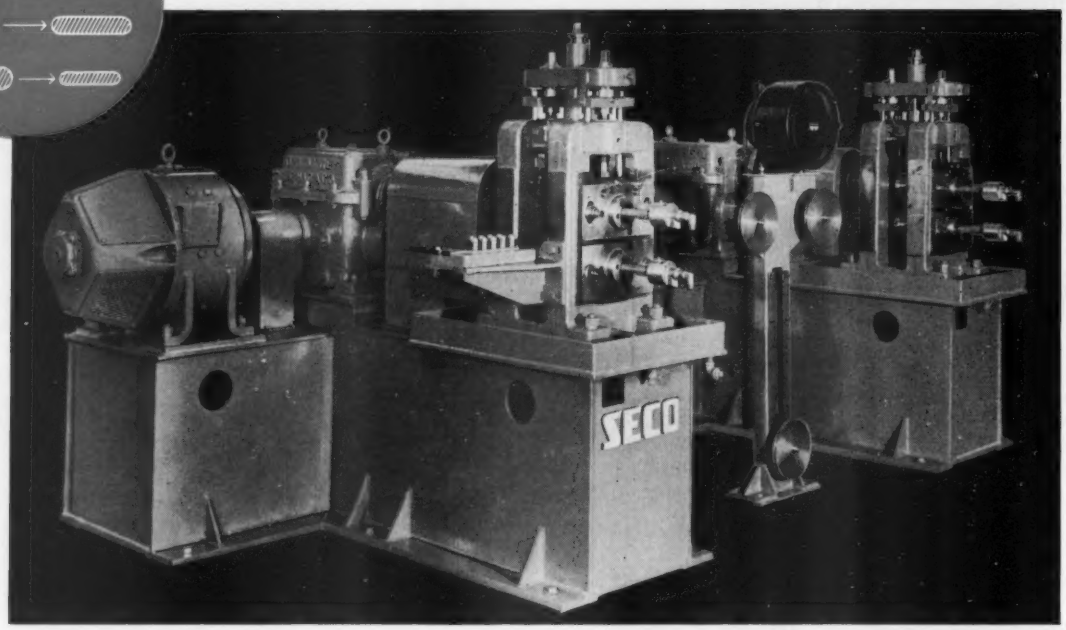
SECO

When You See SECO
You're Seeing the Best!

# Wire FLATTENING MILLS

## Meet Today's High Standards of Quality and Efficient Operation




Shown above is the SECO 6" Tandem Mill with carboloy rolls and Timken Tapered Roller Bearings. Speed range is from 200 to 800 fpm. The mills are driven by DC motors through combination worm-helical reducers with universal joints, for silent and vibrationless operation. 8" and 10" mills of the same design and construction are also available. Suitable traverse reels are furnished.

Call or write for information and complete data. Consultation invited — no obligation.

**STEEL EQUIPMENT COMPANY**
P. O. BOX 737, WARRENSVILLE STATION
CLEVELAND 22, OHIO

SECO

# 100,000,000 PRECISION MADE RIVETS A YEAR

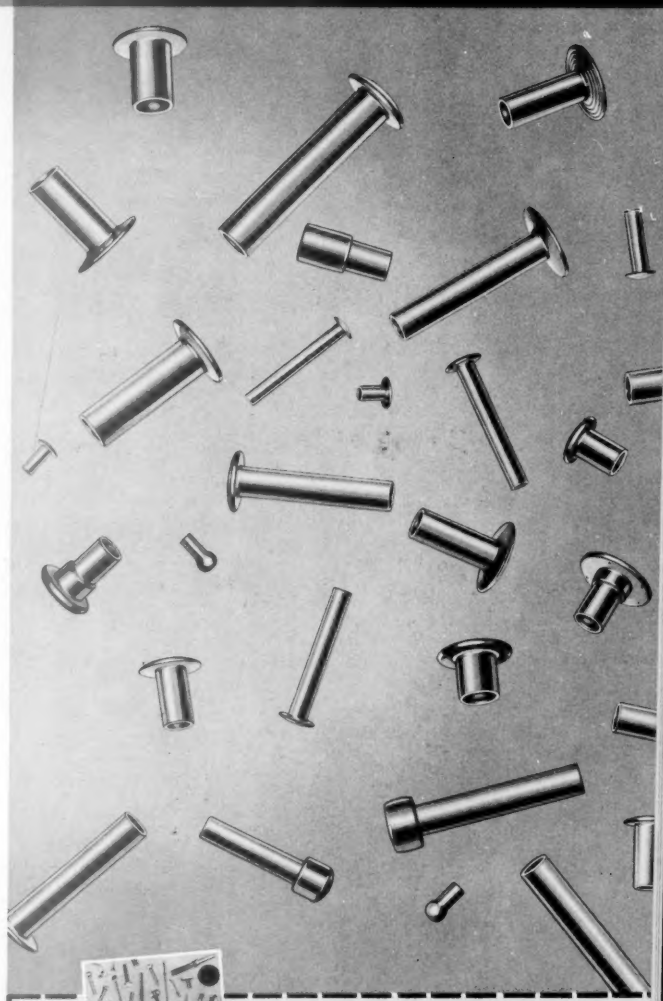
KEYSTONE EXTRUDED TUBULAR RIVET WIRE STUDY

TROJAN RIVET

## Trojan Rivet picks

## KEYSTONE WIRE

## for consistent quality and less trouble



100,000,000 high quality rivets a year prove Keystone extruded tubular rivet wire really makes a difference! George Merta, President of Trojan Rivet Corporation, Glendale, Calif., says, "We have been in the rivet business for seven years and switched to Keystone about three years ago. When the first Keystone Wire arrived, everybody immediately took to it: the operators liked it, it saved on tools and gave less trouble. We just set up the machines and forget it. Our dies last 25% longer and there are virtually no rejects."

*Flowability* is the secret—The superior flow qualities of Keystone extruded tubular rivet wire starts with carefully selected raw materials and embodies special methods of wire making and thermal treatments developed exclusively in Keystone research laboratories. Our metallurgical staff and facilities are available to you.

*Keystone Steel & Wire Company, Peoria 7, Illinois*

**KEYSTONE**
WIRE FOR INDUSTRY

**Keystone Steel & Wire Company**
**Peoria 7, Illinois**

COLD HEADING FACTS FOLDER . . . send coupon today! New folder discusses uses, applications, methods, technical facts, wire requirements.

Name_____ Title_____

Company_____

Street_____

City_____ State_____

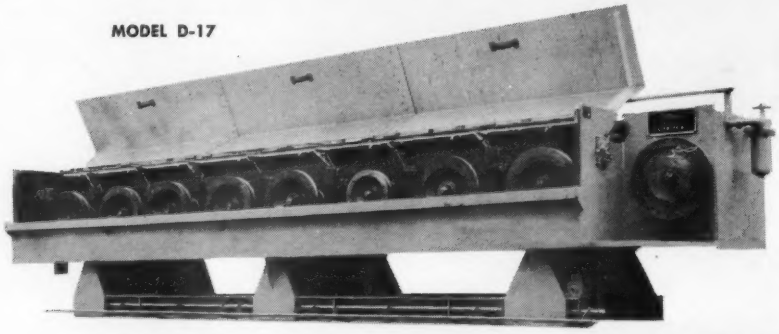
# now, reduce 5/11 16 copper rod to #34 B & S gauge wire in only 2 steps

# COOK

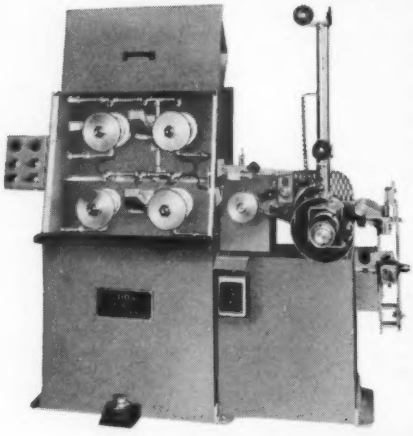
## EQUIPMENT ELIMINATES 1 MACHINE
## LOWERS PRODUCTION COSTS

Now, with only 2 machines, in only 2 production steps, you can reduce 5/16" copper rod to #34 B&S gauge wire. By eliminating one step, you save the cost of one machine and the cost of producing unnecessary intermediate wire sizes. And, with these Cook machines, you'll produce the highest quality wire at speeds up to 5,000 feet a minute.

MODEL D-17



| | |
|---|---|
| Maximum Size of Entering Rod | 5/16" Copper<br>⅜" Aluminum |
| Finished Wire Size | No. 8 to No. 19 B&S Gauge |
| Maximum Operating Speed | 5000 F.P.M. |
| Maximum Number of Dies | 17 |
| Number of Drawing Blocks | 8 |
| Maximum Size of Die Case | 1½" dia. x 1" thick |
| Spool Capacity | 1000 lbs. |
| Spool Traverse | 11" |
| Spool Diameter | 30" |
| Motor Size | 150 HP |



MODEL F-31

| | |
|---|---|
| Maximum Wire Entering Size | #14 B&S Gauge |
| Finished Wire Size | #26 to #34 B&S Gauge |
| Operating Speed | 5000 ft./minute |
| Maximum Number of Dies | 16 |
| Number of Drawing Shafts | 4 |
| Size of Die Case | 1" x ½" thick |
| Motor Size | 15 HP |
| Spool Capacity | 40 to 90 lbs. |
| Spool Flange Diameter | 8" to 12" |
| Spool Traverse | 6" to 8" |

WRITE OR PHONE FOR COMPLETE DETAILS

**COOK MANUFACTURING CO.**

**50 EAST 25th STREET, PATERSON, N. J. * ARmory 4-6380**

CANADIAN AGENT
E. V. LARSON CO., LTD.,
TORONTO, CANADA

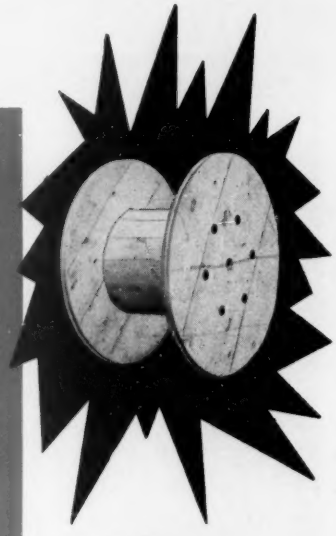
EUROPEAN AGENT
CAPAMADJIAN LE MONNIER CIE LTD.,
PARIS, FRANCE

# NON-RETURNABLE

**WOOD REELS IN ALL SIZES FOR ALL TYPES OF ELECTRIC WIRE AND CABLE . . .**

B. J.—
This looks interesting to us in Production. Suggest you investigate Bridge Reels today. Advise me when you hear from Bridge
A. J. G.

# YES

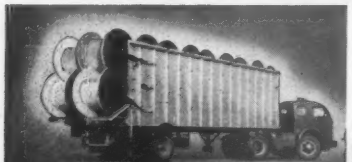


## YOU SAVE WITH NON-RETURNABLES

**LOOK AT THE ADVANTAGES**

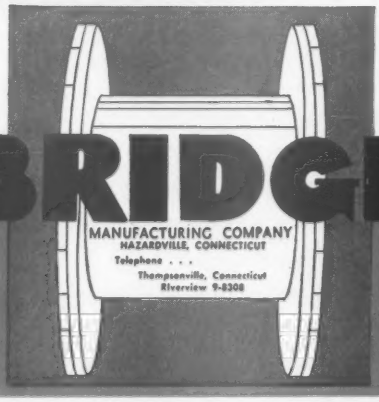
- **Reduce Reel Investment**
- **Less Storage Space**
- **Lower Freight Cost**
- **No Bookkeeping**
- **No Repair Costs**
- **No Return Freight**
- **No Deposit**
- **No More Headaches**

NON-RETURNABLE REELS GIVE YOU A DEFINITE PACKAGING COST



**HIGH SPEED**
**SHIPPING SERVICE IN OUR OWN TRUCKS**

within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels within a few days east of the Mississippi.



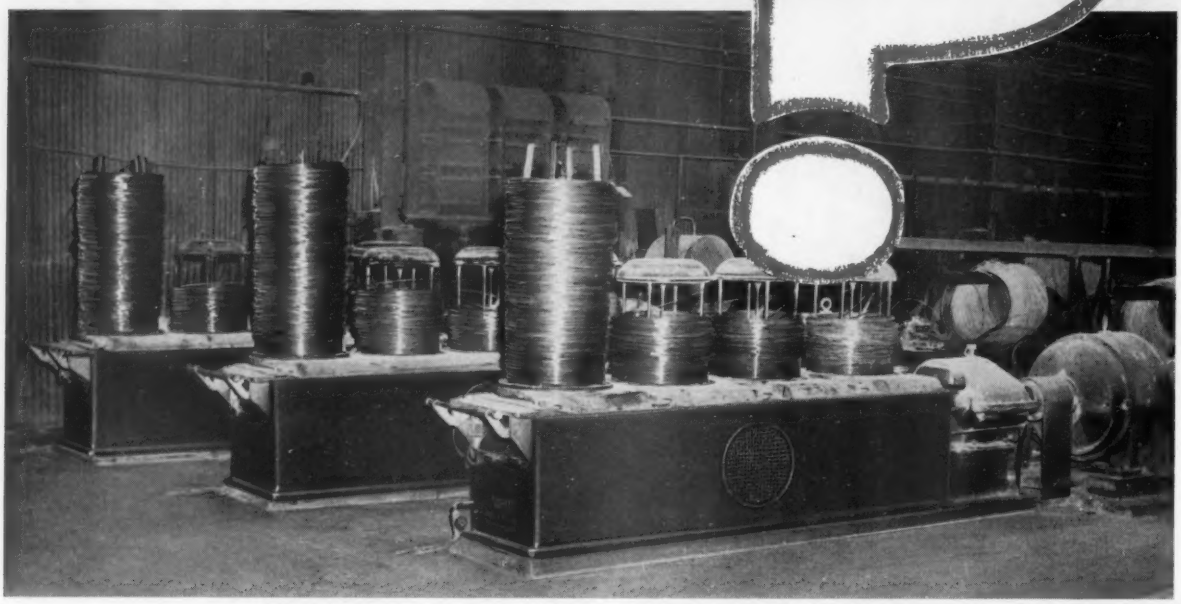
**BRIDGE**
MANUFACTURING COMPANY
HAZARDVILLE, CONNECTICUT
Telephone . . .
Thompsonville, Connecticut
Riverview 9-8308

***"REEL GOOD . . .***

Let us quote on your reel needs. Send us your specifications. Better yet, visit our plant and see how and why Bridge reels are made so well at so low a cost.

***WOOD REELS"***

# *want* **BIG** *bundle capacity*



*. . . then try* **MORGAN-CONNOR** wire machines. The Morgan-Connor Machine is a nonslip, continuous, dry wire drawing machine. Morgan machines will give you maximum weight bundles at the lowest possible cost.

MORGAN WORCESTER

## MORGAN-CONNOR
### WIRE MACHINES

WM 110

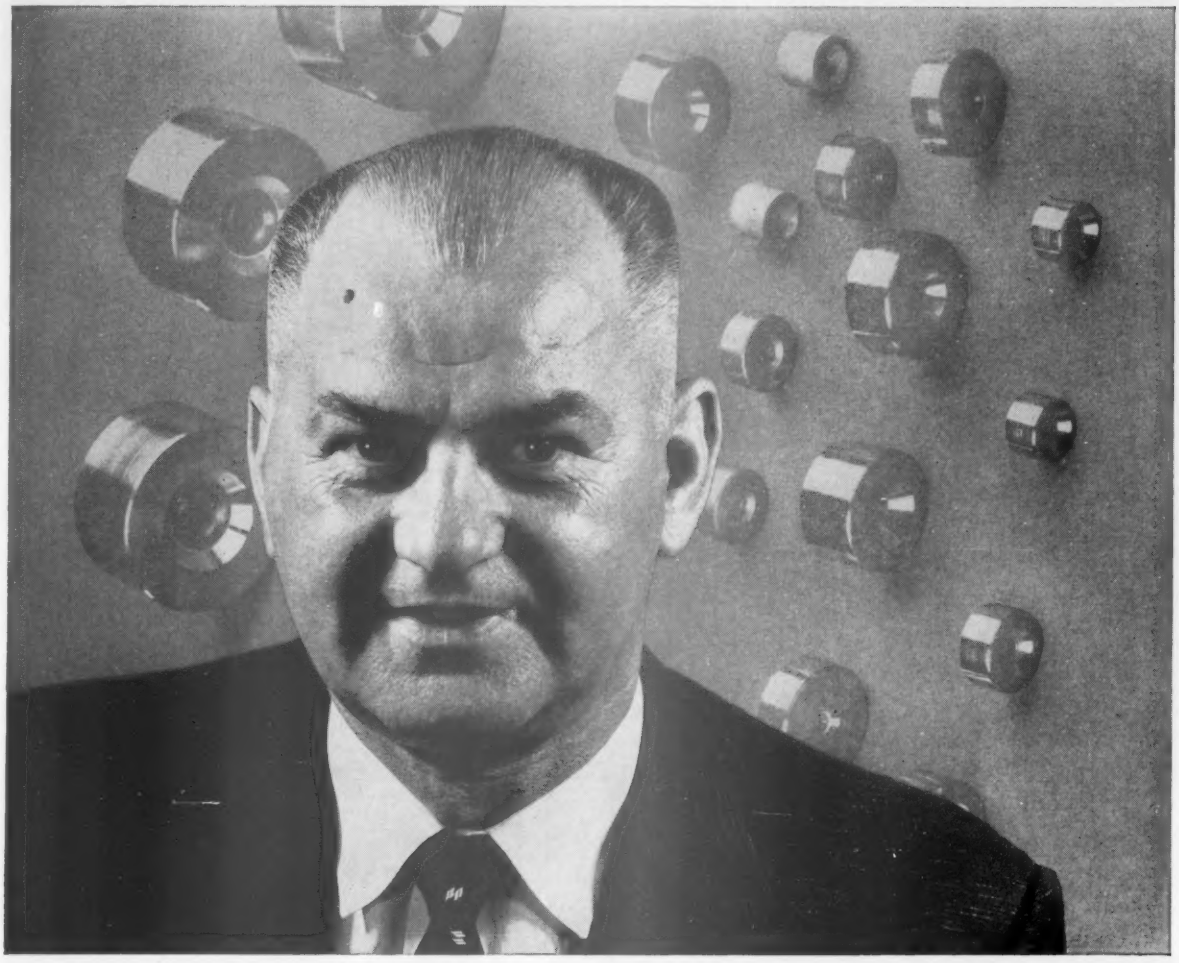
**MORGAN CONSTRUCTION COMPANY** WORCESTER, MASS.

ROLLING MILLS • MORGOIL BEARINGS • WIRE MILLS • REGENERATIVE FURNACE CONTROL • EJECTORS • GAS PRODUCERS

S. S. Rickley, Representative, 300 Cedar Blvd., Pittsburgh, Pennsylvania

# Firth Sterling ...

PIONEER IN POWDER AND MOLTEN METALLURGY



## Picture of the "Plus Value" in Firthaloy Dies

Chances are you've recognized Eddie Miller's picture above. There's also a good chance that he's helped you—with plant layout, purchase of equipment, die design, or in a dozen other ways—just as he's helped so many others during the past quarter of a century. That's why he and his staff have become a symbol of the "plus value" you get in Firthaloy Carbide Dies.

This unequalled knowledge and experience is yours for the asking. When you add this "plus value" to the recognized superiority of Firthaloy Carbide Dies for longer wear, better finish, and lower costs, you have a combination that can't be beat.

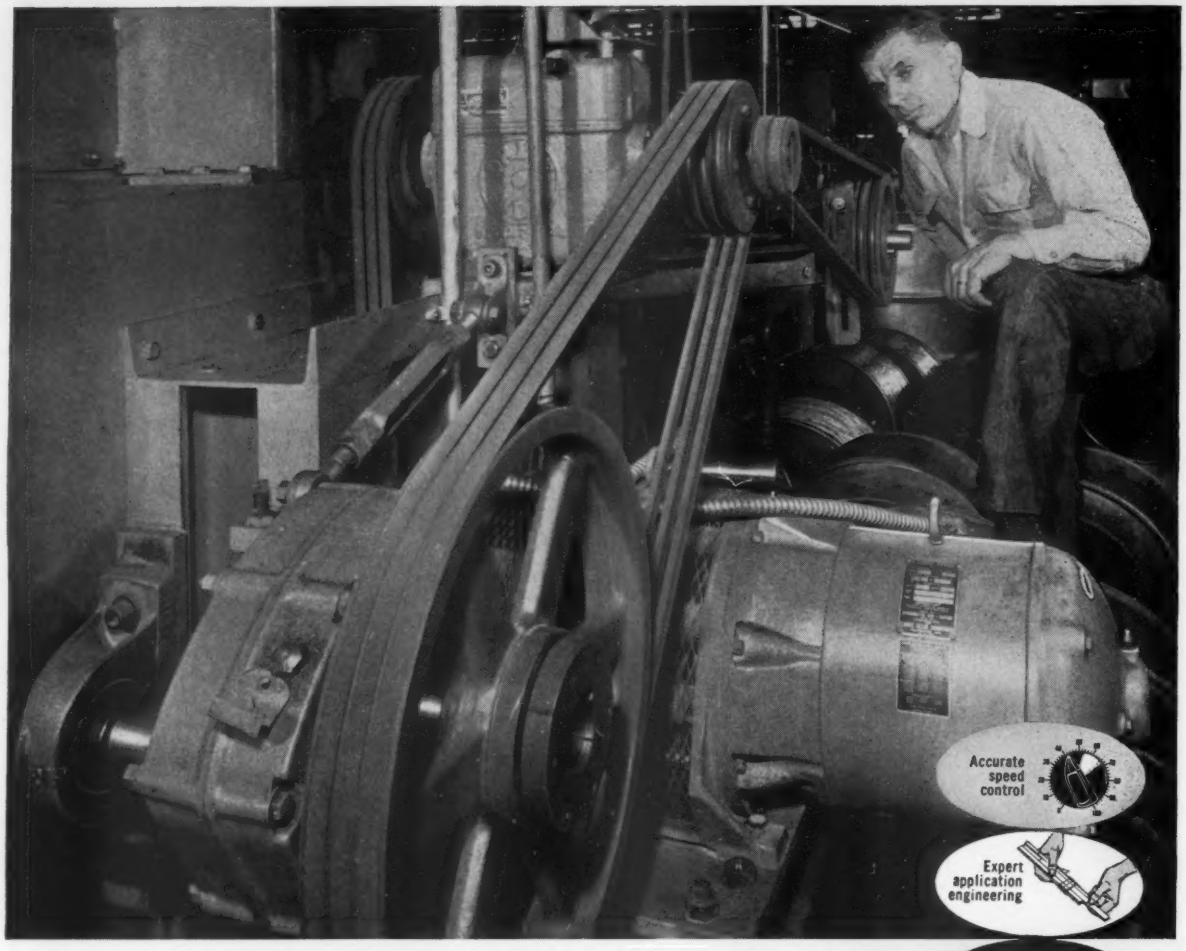
To add Eddie Miller to your staff, but not to your payroll, write: Eddie Miller, Firth Sterling, Inc., 3113 Forbes Avenue, Pittsburgh 30, Pa. Offices and warehouses in principal cities.

*"Your Future is Great in a Growing America"*

PRODUCTS OF *Firth Sterling* METALLURGY

HIGH SPEED STEELS • TOOL & DIE STEELS • STAINLESS SPECIALTIES • HIGH TEMPERATURE ALLOYS
SINTERED TUNGSTEN CARBIDES • HEAVY METAL • CERMETS • CHROMIUM CARBIDES
ZIRCONIUM • STERVAC & STERCON SUPER ALLOYS

FIRTH STERLING TRADE MARK




# Louis Allis drives double production at Central Cable Company

## Ajusto-Spede® drives improve extruding operation — cut costs 75% — slash rejects 90%

Central Cable Company, of Freeport, Illinois, is a major manufacturer of utility cable. In recent years they decided to improve their cable insulation by going to the extrusion process.

To power their extrusion lines, they found that of all the drives available, Louis Allis Ajusto-Spede® A. C. drives offered the greatest flexibility and precise speed control. Result: production increased 100% . . . manpower costs dropped from $240 to $60 per day . . . rejection rate because of improper insulation dropped from 10% to less than 1%.

Adjustable speeds from 0 to 1400 fpm permit coating of varying cable sizes without changing mechanical set-up. Precise "one-dial" master speed control assures positive speed relation between extruder, capstan, and takeups—permits uninterrupted processing — maintains proper wire tension from initial feed through windup on shipping spools.

In addition, Louis Allis drives are controlled by one potentiometer, eliminate need for ac-dc converter. Equally important, the Louis Allis drives at Central Cable Company have not had a single breakdown since their installation in 1948 — nor have they required replacement or repairs of any kind.

For modernizing — or a new installation — consult Louis Allis *first*. Contact your nearby Louis Allis District Office or write to The Louis Allis Company, 451 East Stewart Street, Milwaukee 1, Wisconsin.

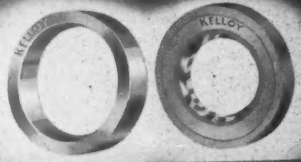
**LOUIS ALLIS**

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

FOR PRECISION AND ACCURACY

Specify "KELLOY" CARBIDE SHAPE DIES

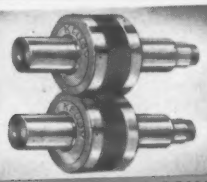
WEAR RESISTANT PARTS. BUSHINGS, GUIDES, CRIMPING, EDGING AND COATING DIES, etc.



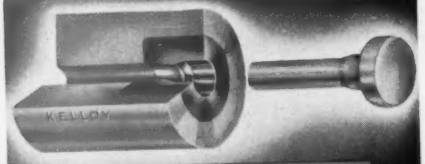

CAPSTAN RINGS FOR WIRE DRAWING OPERATIONS. FOR EYELETS & DEEP DRAWN PARTS. ANY SHAPES.

NON-FERROUS SHAVING DIES

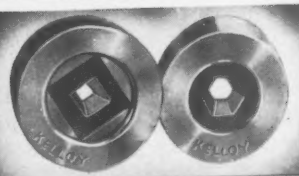
FOR SPRING FORMING. ALL TYPES OF SPRING TOOLING.



WIRE FLATTENING ROLLS. TRUE SURFACE FOR HIGH QUALITY FLAT WIRE.




BOLT SIZING DIES. COMPLETE AND READY TO USE. CLOSE TOLERANCES.




SHAPE DIES WITH SHARP TRUE CORNERS FOR ACCURATE PRODUCTION.

SIDE AND END BLOCKS. COLLAPSIBLE DIES FOR DRAWING BAR STOCK.

KELLOY CORPORATION
17 WEST 34th. STREET NEW YORK 1, N. Y.

Crawford Door Company uses J&L superior quality, oil-tempered spring wire in 18 sizes for torsion and extension springs. Springs range from a few feet long to giants over 12 feet long, capable of raising 3,500-pound industrial doors without effort.

# "UNIFORM HEAT TREATING AND TEMPERING PAYS OFF IN SUPERIOR J&L SPRING WIRE"

## ...says Crawford Door Co. official

"J&L has a superior spring wire because of the control they are able to maintain in their heat treating and tempering operations," reports Mr. Jerome Fansler, vice-president of the Crawford Door Company, Detroit, Michigan.

"J&L spring wire is properly tempered. This means the wire will coil uniformly. There are no surface imperfections or potential breaking points."

Crawford Door uses J&L oil-tempered medium basic spring wire for torsion and extension springs. They buy 18 sizes, ranging from .192 (13/64") to .293 (19/64").

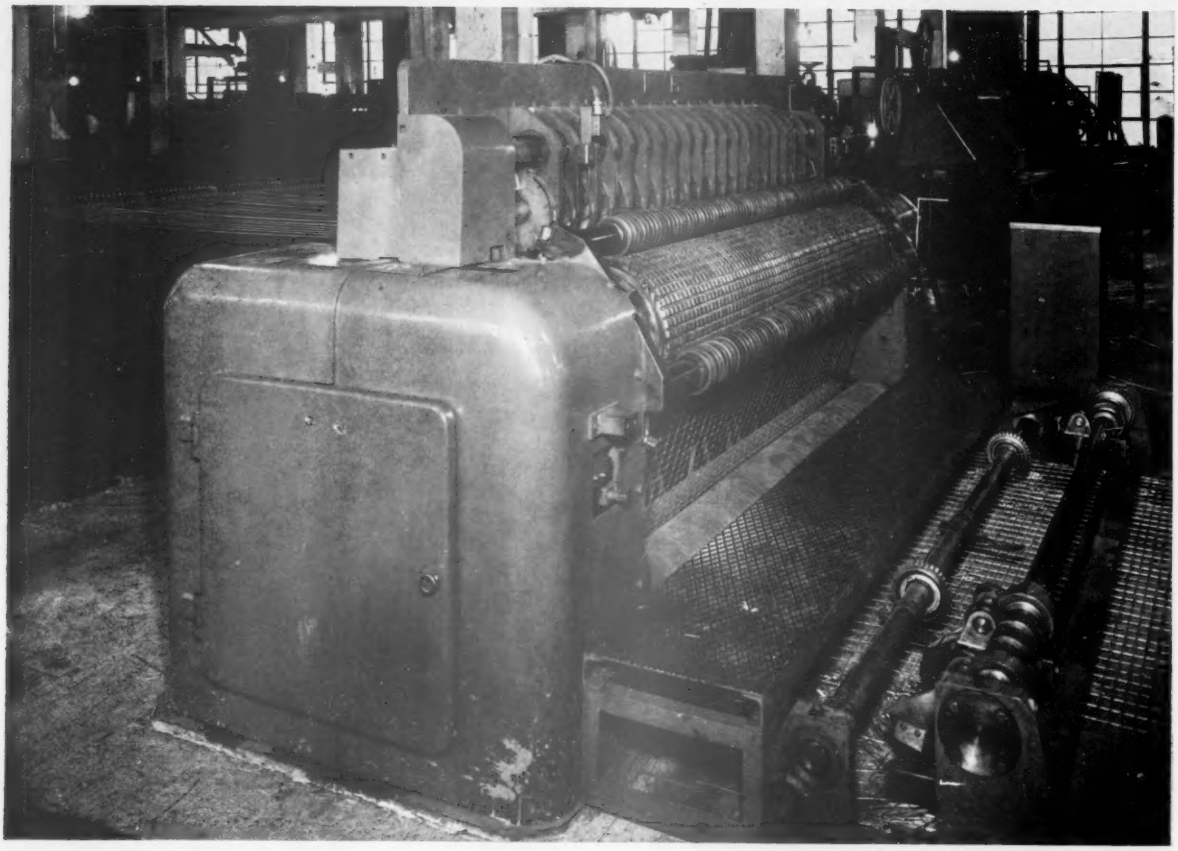
Every coil of J&L spring wire is thoroughly tested for uniformity of physical and dimensional properties. This uniformity can speed your production, reduce the number of rejects. J&L has complete control of wire quality from ore through finished product. When you specify J&L, you are sure of wire that is tops in quality yet competitive in price.

Next time you buy wire, call in your J&L representative for fast, satisfying service. Or write direct to Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

J&L STEEL

**Jones & Laughlin Steel Corporation**

PITTSBURGH, PENNSYLVANIA



# E V G *"Europe's Most Experienced"*

now adds the BUDGET wire fabric welder to its line. Special purpose and fully automatic, the BUDGET welder is specifically designed to produce reinforcing fabric 6x6: 10-10 and similar constructions. A complete plant at exceptionally low initial investment.

**E V G designs and builds the world's most complete line of fabric welding machinery—four standard plants covering the entire field of welded wire fabric:**

The **HEAVYDUTY** (Type G6)—Designed to produce the heaviest meshes (pipe fabric, etc.); wire sizes up to 7/0.

The **UNIVERSAL** (Type G5)—For all standard constructions of road slab-reinforcing, building mesh, etc.—wire sizes from 3/0 to 11 gauge.

The **PRECISION** (Type GZ)—For fencing and all types of visual mesh. Accurate welding in the lightwire range (gauges 10-17).

The **HI-SPEED** (Type KFR)—Operating in the fine wire range (gauges 16-22). Mesh spacings as small as ½"x½".

**Carefully calculated capacities mean surprisingly low new equipment costs. Specifications and performance data upon request.**

***Please direct inquiries to***

**Entwicklungs Verwertungs Gesellschaft Graz, Austria**

## RICHARD E. KLEINHANS

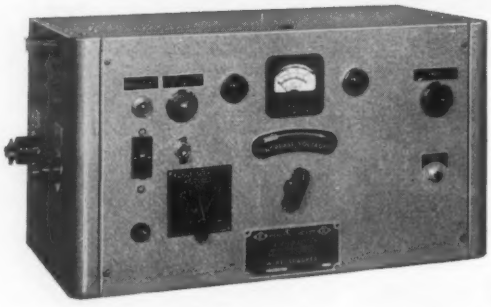
**122 E. 42nd St., New York 17, N. Y.**
**OXford 7-0770**

**Maschinen and Stahl, A.G. Zurich, Switzerland**

# *For Production and Quality Switch to*

"Production up 50%, Quality improved 40% since our switch to Entwistle Hi-Speed Dual Take-Up and Type GR Sparker". This is what Rex Corporation has to say about the Wire Industry's most advanced Take-Up and reliable Spark-Testing Equipment.

## *Wire Sparker Units*



TYPE G

TYPE GR

- **High Sensitivity, High Speed Electronic Fault Detectors.**
- **Regulated Secondary Currents of 10 M.A. or less.**
- **Thirty Different models in all price and voltage ranges.**

TYPE M or MR

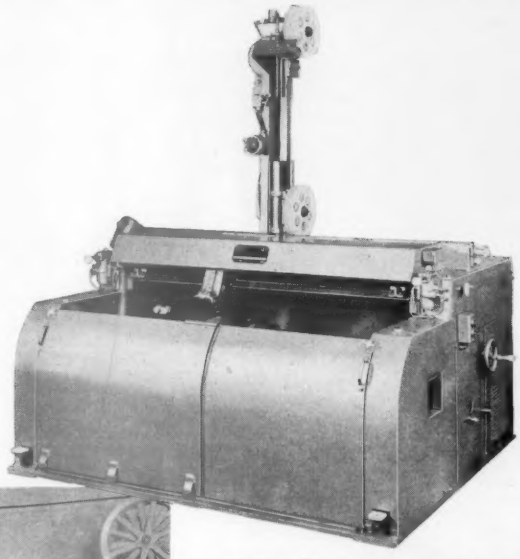
**TYPE G**
10 M.A. Secondary Current
500 V to 5000 V test range
maintained fault signal
application — reeling, coiling, spooling, etc.

**TYPE GR**
10 M.A. Secondary Current
500 V to 5000 V test range
momentary fault signal
application — extruder lines, twisters, etc.

**TYPE M or MR**
10 M.A. Secondary Current
3000 V to 15,000 V test range
maintained or momentary fault signal
application — reeling, coiling, spooling, extruder lines, twisters, etc.

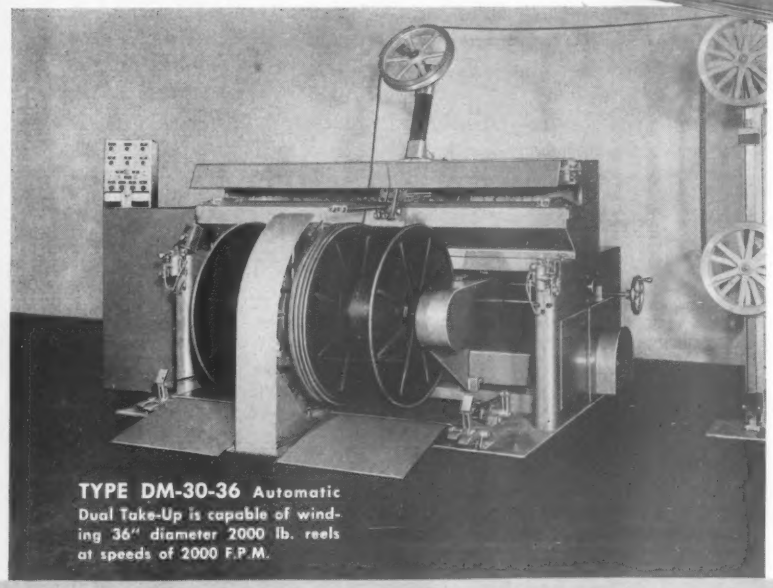
# ENTWISTLE

**HIGH SPEED**
**AUTOMATIC DUAL**
*Shaftless Take-ups*



**TYPE DM-18-24** Automatic Dual Take-Up is capable of winding 24" diameter 1000 lb. reels at speeds of 3000 F.P.M.

- Speeds to 3000 F.P.M.
- Positive Automatic Wire Transfer
- Maintained Spooling Tension
- Pneumatic Reel Engagement
- Hydraulic Reel Lift
- Hydraulic Traverse



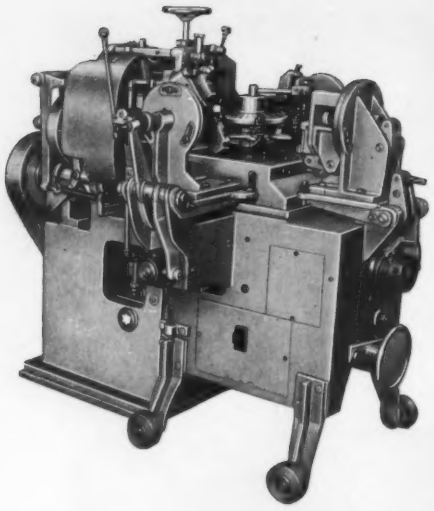
**TYPE DM-30-36** Automatic Dual Take-Up is capable of winding 36" diameter 2000 lb. reels at speeds of 2000 F.P.M.

Europe, South America, Mexico
FOREL EQUIPMENT CORPORATION
43 Church Street, New York 30, New York

ENTWISTLE
Manufacturing Corporation
1473 ELMWOOD AVE., PROVIDENCE 7, RHODE ISLAND
*Over 40 years of dependable service to the Wire Industry*

British Associates
THE KEMSON ENGINEERING CO., LTD.
Wellington Mill, Bolton Road
Blackburn, Lancs., England

Wafios



# AUTOMATIC SPRING COILING— LOOPING MACHINE

## *Here It Is ! !*

The F I R S T fully automatic Universal Spring Coiling and Looping Machine for the production of extension springs looped on both ends. The loops can be made parallel or at any angle to each other. The uniformity of placement of loops and length of springs far surpasses results achieved by "old fashioned" methods.

It is not only possible to produce springs with normal loops, half open loops or machine loops, but, also springs having two different styles of loops.

***The ZO Series of Coiler-Loopers are available in 2 Models:***

| | | |
|---|---|---|
| Model ZO/15: | Wire Diameters: | .0197" to .0475" |
| | Lengths of Springs: | .750" to 5½" |
| | O. D. of Springs: | .200" to ⅝" |
| Model ZO/30: | Wire Diameters: | .0394" to .118" |
| | Lengths of Springs: | 1¾" to 7" |
| | O. D. of Springs: | .394" to 1" |

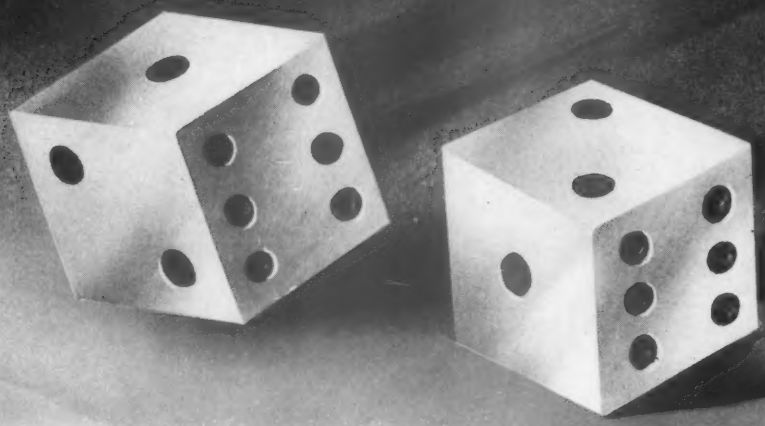
**Production on both Models up to 40 complete springs per minute.**

## WAFIOS MASCHINENFABRIK REUTLINGEN / Germany

KO CO., INC
INDUSTRIAL IMPORTERS

**KURT ORBAN CO., INC.**
**34 Exchange Place**
**Jersey City 2, NEW JERSEY**

# WHY GAMBLE?



**WHEN**

**GLADER NAIL MACHINES** HAVE A RECORD OF OVER SIXTY YEARS OF PROVEN PERFORMANCE.

— **GLADER NAIL MACHINES** ARE AVAILABLE IN ELEVEN SIZES TO ANSWER EVERY NAIL MAKING PROBLEM.

— **GLADER NAIL MACHINES** GUARANTEE MAXIMUM PRODUCTION WITH MINIMUM MAINTENANCE COST.

— **GLADER NAIL MACHINES** OFFER INCOMPARABLE VERSATILITY OF PRODUCT AND ABILITY TO PROCESS WIRE WHERE OTHERS FAIL.

— **GLADER NAIL MACHINES** ARE USED WITH GREAT SUCCESS THROUGHOUT THE WORLD

— **GLADER NAIL MACHINES** OFFER THE ULTIMATE IN RUGGED CONSTRUCTION AND SIMPLICITY OF ADJUSTMENT.

WRITE FOR DESCRIPTIVE BULLETIN

WM. **GLADER** MACHINE WORKS

210 N. RACINE AVENUE • CHICAGO 7, ILLINOIS

EXPORT DEPT., 122 EAST 42ND STREET • NEW YORK 17, N. Y.

# TINSELS

**ALL TYPES AND SIZES**

## BARE ELECTRIC TINSEL CONDUCTORS

Used in cords for: Telephones—Radios—Electric Shavers —Hearing Aids. Used bare for voice coil lead wires on loud speakers.

## SILVER COATED COPPER WIRE

For Stranded Cables. ASTM Designation B 298-55T

## TINSEL LAME (FLAT WIRE)

Silver and False Gold Coated Copper—Aluminum Slit-foil for Tinsel Ribbons and Garlands.

## KNITTED MESH AND CURLED WIRE— FLAT AND ROUND

For Muffling of Sound
For Air Conditioning and Oil & Gas Filtration and Entrainment
For Vibration & Shock Absorbing Cushions
For Electronic Shield
For Filters & Mist Eliminators

## POT CLEANERS

Stainless Steel Sponges
For Use in Home, Shop, Garage
Cleans Broilers, Grills, Fry Pans
Will Not Discolor Enamel

## FOR INDUSTRY—RESTAURANTS

Kitchens of Institutions, Meat Packers
For Cleaning up Utensils, Used in Baking Hams and Other Meats, in Factories, Frying Potato Chips, Barbecuing of Chickens and so forth

*Write or telephone to Tinsel Headquarters for quotations on your tinsel requirements.*

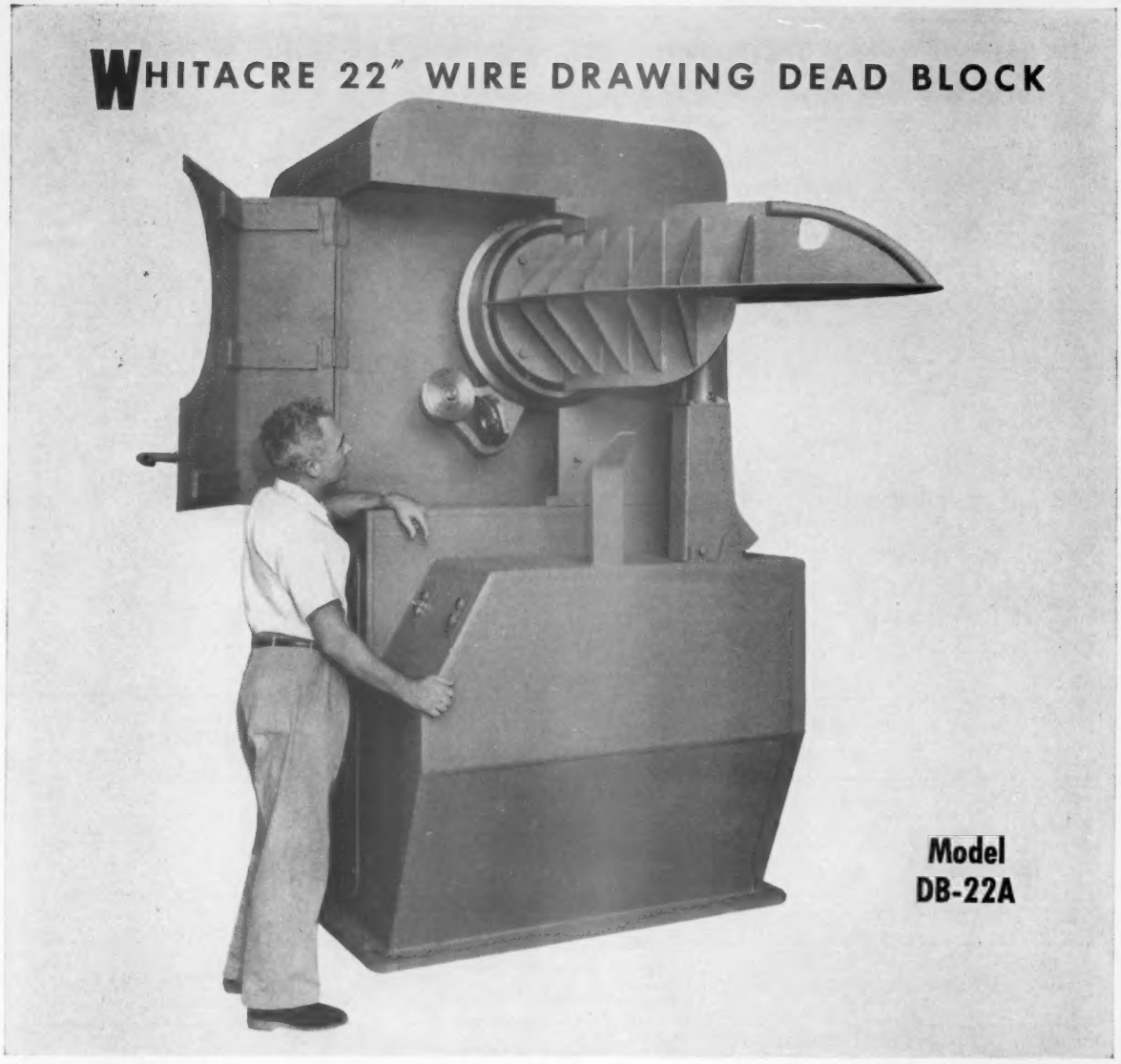
# THE MONTGOMERY COMPANY

**ESTABLISHED IN 1871**

25 CANAL STREET • WINDSOR LOCKS, CONN.

***Telephone: Windsor Locks NATIONAL 3-3336***

# WHITACRE 22″ WIRE DRAWING DEAD BLOCK




## *Continuous Production—Efficiency Approaching 100%*

### Gives you these advantages

Continuous increased production achieved by: • No down time for stripping • Permits packaging into stationary container or uninterrupted palletizing on stems • No tangling nor snarling from handling • Design simplicity. No back-gearing nor similar mechanisms • Greatly reduced floor space requirements • Dies in supplying drawing machine can be changed without stopping dead block • Accumulation type machines can be "run down" without stopping dead block • Continuous inspection and sampling • Breaks welded in production — low scrap loss • Increased production with lessened operator fatigue • Maintenance eliminated except for occasional lubrication of four main bearings and two motor bearings • Dead block can be located anywhere with wire literally piped from wire drawing machine • Extra large packages for in-process wire • Greatly reduced handling and in-plant transportation costs • Low capital investment.

**OTHER MODELS AVAILABLE**

16″ Wire Drawing Dead Block, Model DB-16A • 26″ Wire Drawing Dead Block, Model DB-26A • Combination 16″ and 22″ Galvanizing or Tinning Dead Block Take-ups, Model GB-2216A • 26″ Heavy Wire Galvanizing or Tinning Dead Block Take-up, Model GB-26B.

Write Today For Specifications And Name Of Nearest Distributor

**WHITACRE ENGINEERING & MANUFACTURING COMPANY**

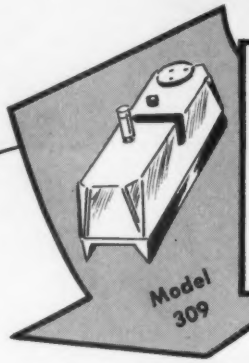
5649 ALHAMBRA AVENUE • LOS ANGELES 32, CALIFORNIA • CAPITOL 5-2476

WHITACRE

# Upgrade Quality and Reduce Costs

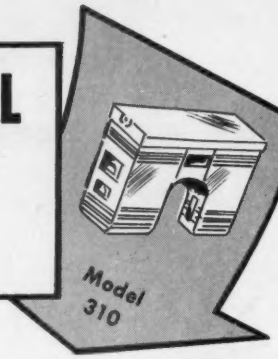
## ...at the same time

***SELECT A PAGE FROM OUR BOOK*** for more profit with *automatic* control of wire and cable diameter.




## MICROLIMIT CONTROL

**Continuous, Non-Contact Measurement Automatic Control of Diameter of Insulated Wire and Cable in Production**




| | Model 309 | Model 310 |
|---|---|---|
| **RANGE** | .001 - .750 inches. | .075 - 3.0 inches. |
| **SENSITIVITY** | 0.1 mil | 1.0 mil |
| **RECOMMENDED LOCATION** | | |
| **C.V. PROCESS RUBBER (Vertical or Horizontal)** | A Model 310 Exclusive | Between die and splice box or between splice box and first section of tube. |
| **PAN CURE RUBBER** | Between extruder and talc box. | Between extruder and talc box. |
| **PVC & PE EXTRUDERS** | Between water trough and capstan or between capstan and take-up. | Between extruder and water trough. |
| **TEFLON EXTRUDERS** | Between extruder and first sintering oven. | A Model 309 Exclusive |
| **SILICON EXTRUDERS** | Between extruder and oven. | Between extruder and oven. |

**With the MICROLIMIT CONTROL you will realize—minimum starting scrap — lower labor costs — reduced material consumption — improved quality.**

*For further information—*

**INDUSTRIAL GAUGES**
**DAYSTROM-WESTON INDUSTRIAL DIVISION**
**DAYSTROM INCORPORATED**

WEST ENGLEWOOD, NEW JERSEY

Coulter & McKenzie D-PAKer shown above

**EASY LOADING • EASY DISPENSING • EASY STACKING**

Forget about the time and trouble involved in splitting, tying and wrapping wire! Continental's Payoffpak accommodates up to 100 pounds of fine wire as fast as it's drawn or annealed. This is the most practical—and most economical—way to pack, ship, store and dispense fine wire, ferrous or nonferrous. Superbly lithographed by Continental to do a real selling job for you, Payoffpaks are economically priced for one-time use. Call or write Continental *today*.

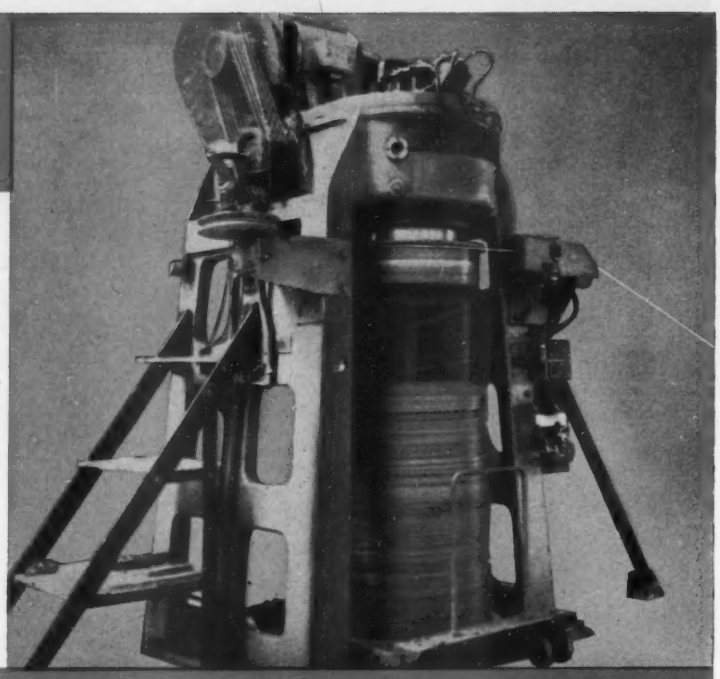
**CONTINENTAL CAN COMPANY**

Eastern Division: 100 E. 42nd St., New York 17
Central Division: 135 So. La Salle St., Chicago 3
Pacific Division: Russ Building, San Francisco 4

Payoffpak has a sturdy bail, smooth slick interior, and necked-in bottom for secure stacking. No need of reels or wide range of block sizes in filling . . . longer length of continuous strand means reduced downtime for your customers.

EITHER LUG OR RING SEAL TYPE CLOSURE PROVIDES TRUE AIRTIGHT SEAL!

# Introducing



## GRAVITY BLOCK MACHINE

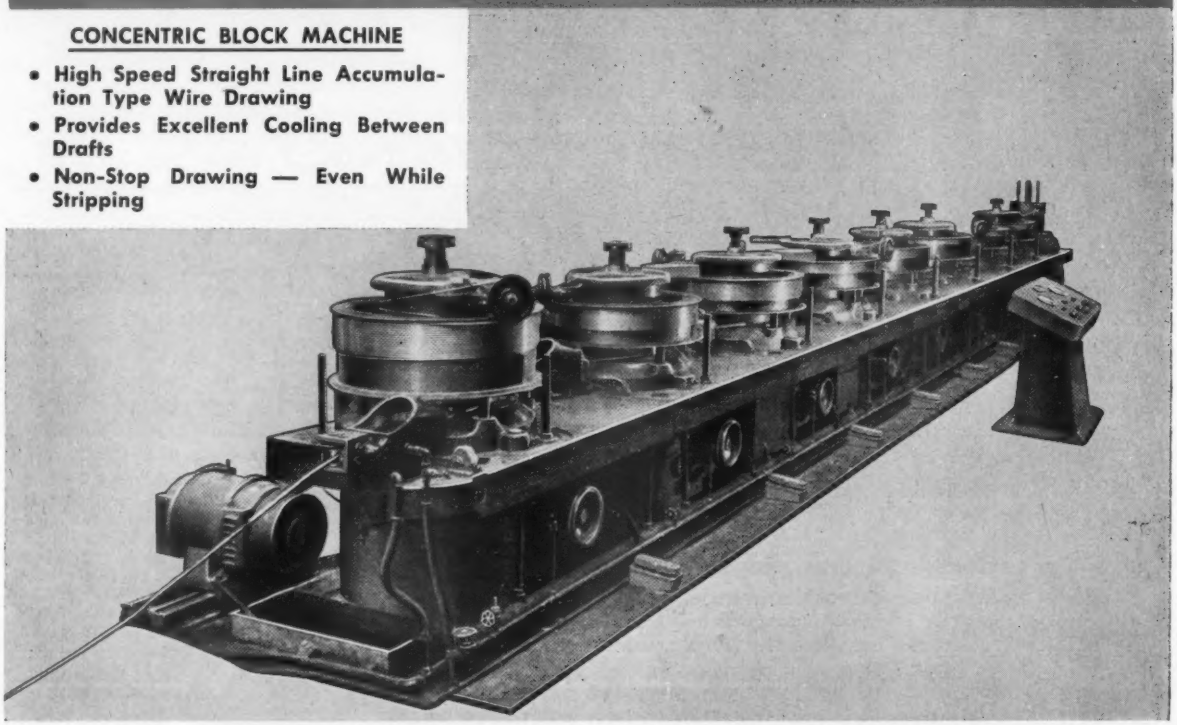
- Available in Single or Double Draft Design
- Block Diameters From 18" to 30"
- Coil Sizes—2,000 Pounds & Larger
- High Speed Stripping
- Ease of Handling Large Coils

The Sir James Farmer Norton & Company, Ltd. of Manchester, England, manufacturers of the famous line of Farmer Norton Wire Drawing and Fence Making Machinery have appointed the Steel & Wire Machinery Co. of Cleveland, Ohio, as exclusive Sales Agents in the United States.

# FARMER NORTON

## CONCENTRIC BLOCK MACHINE

- High Speed Straight Line Accumulation Type Wire Drawing
- Provides Excellent Cooling Between Drafts
- Non-Stop Drawing — Even While Stripping



**EXCLUSIVE U.S. AGENTS FOR WIRE DRAWING & FENCING MACHINERY**

Steel & Wire machinery co.

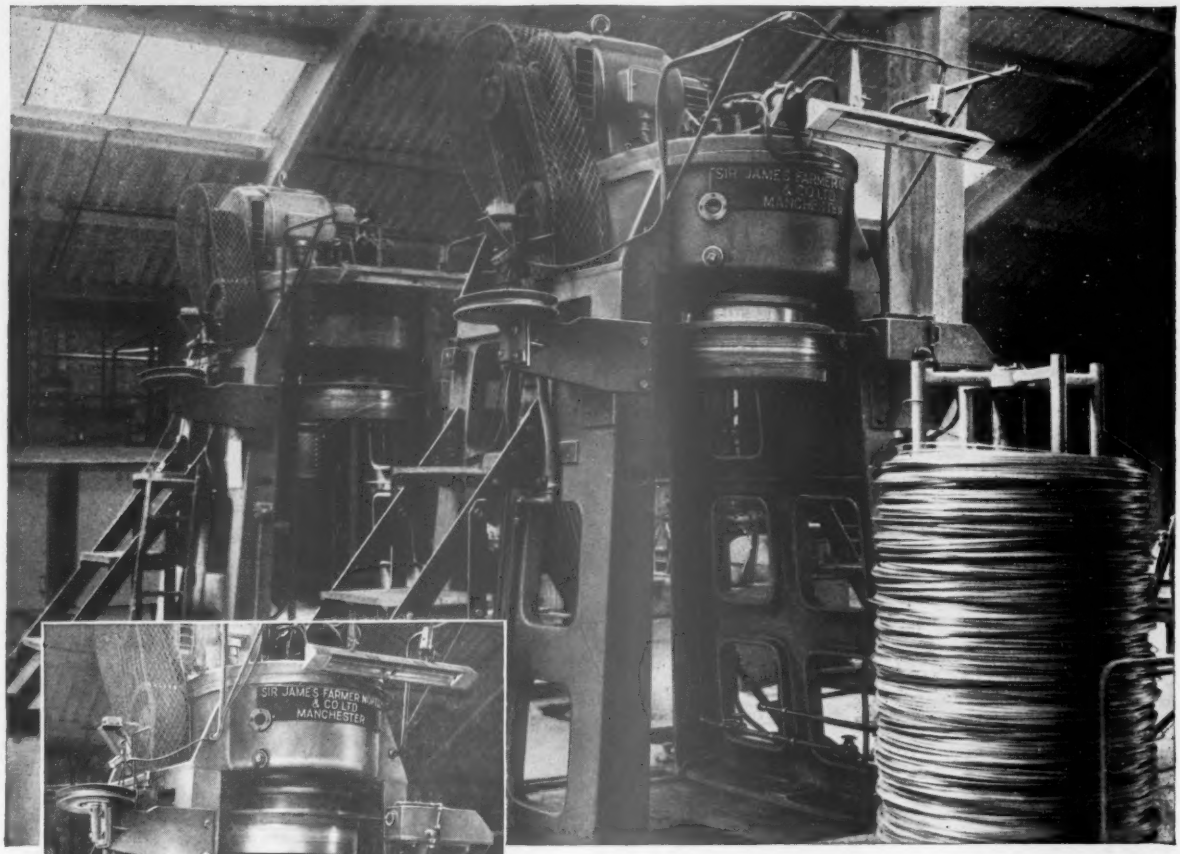
EQUIPMENT FOR THE MANUFACTURE OF STEEL AND WIRE PRODUCTS

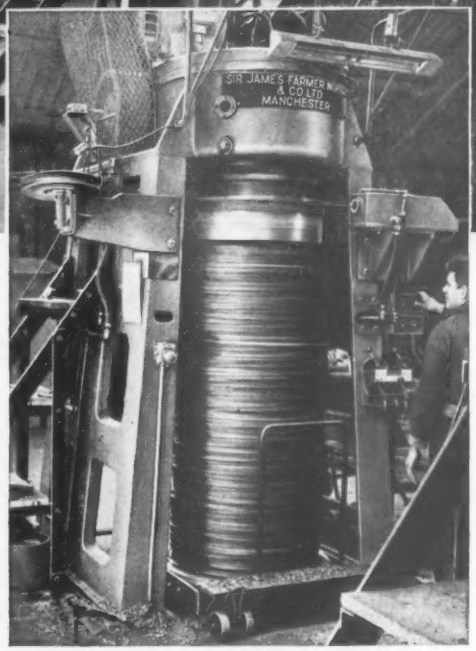
**FARMER NORTON**
Draw Benches, Rolling Mills, Flattening Mills Slitters & Pointers

15457 EUCLID AVENUE • CLEVELAND 12, OHIO

# Farmer Norton

## *wire drawing machinery*




*Photographs by courtesy of G.K.N. Reinforcements Ltd.*

The above shows a double draft Gravity block drawing ton coils of steel wire for the manufacture of reinforced concrete fabric. This machine is capable of drawing all sizes from ½" rod down to 12 s.w.g. in double or single drafts.

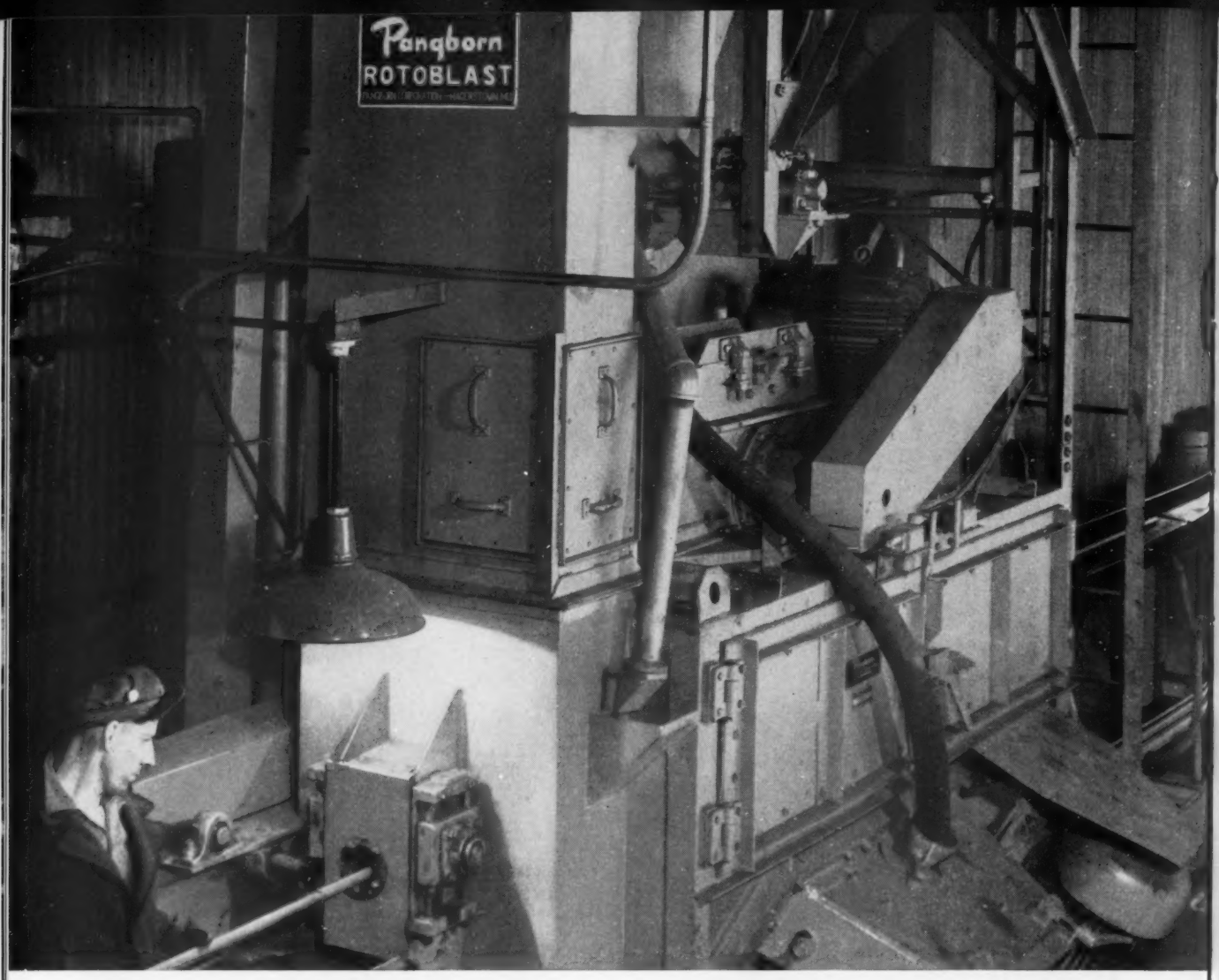
**THIS SYSTEM ENSURES**

- ★ high machine efficiency
- ★ reduction in handling times and ease of handling after drawing
- ★ long runs on the fabric making machines, which obviate machine stoppages for welding and changing swifts

*Makers of all classes of Wire Drawing Machinery and pioneers of the inverted block system for handling large coil weights.*

## Sir James Farmer Norton & Co. Ltd.

**ADELPHI STREET • SALFORD • LANCASHIRE • ENGLAND**




# High-speed Pangborn Rotoblast Descaling Machines eliminate pickling, permit automation in wire drawing!

THOROUGH . . . Rotoblast descaling eliminates the need for pickling . . . rod can be drawn without further cleaning.

WORKABLE . . . Rotoblasted finish provides excellent base for lubricant or drawing compound, fine bonding surface for coating.

VERSATILE . . . Pangborn Descaling Machines handle cut lengths or coils, designed for single or multiple strand descaling.

LOW-COST . . . Operating costs and manpower requirements are held to a minimum.

CONTINUOUS . . . These machines eliminate multiple handling necessary for batch descaling and coating operations, fit into fully automated wire drawing production line.

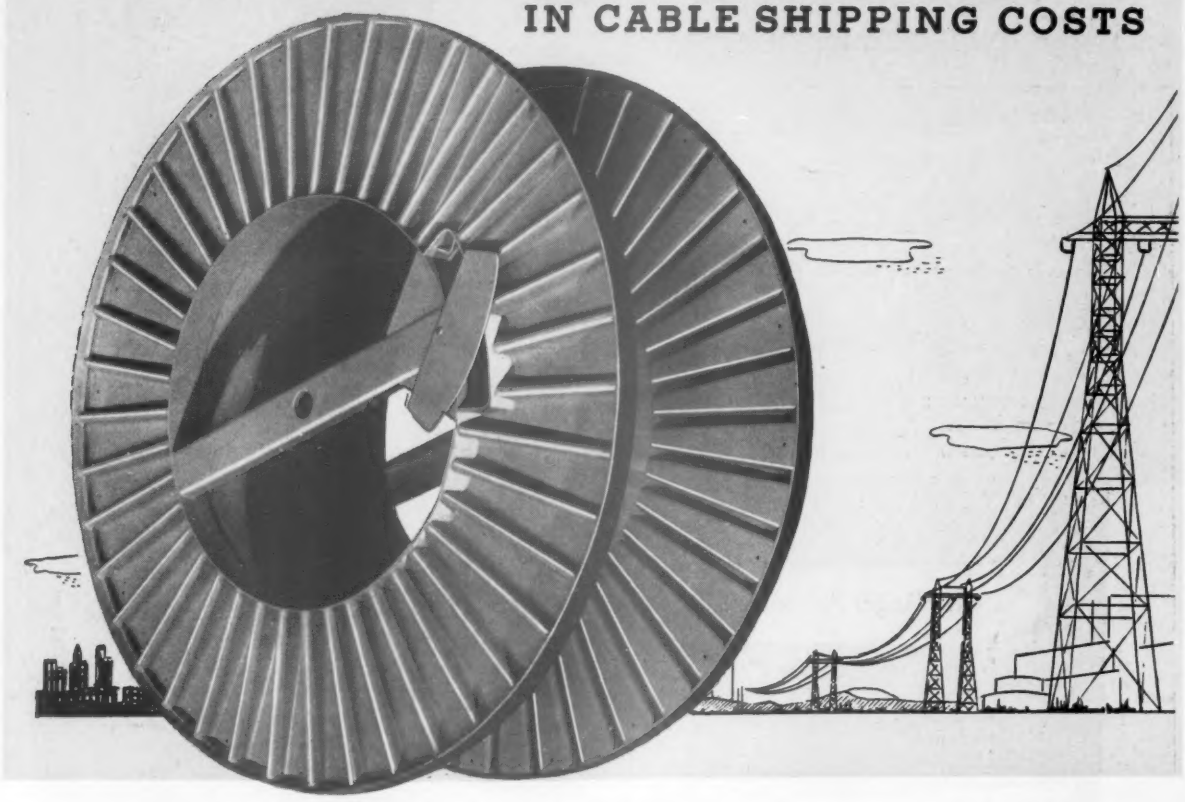
FOR DETAILS . . . talk to your Pangborn district engineer or write PANGBORN CORPORATION, 5400 Pangborn Blvd., Hagerstown, Maryland.

**Clean it fast with Pangborn ROTOBLAST®**

20-YEAR RECORD REVEALS

# GREAT REDUCTION

IN CABLE SHIPPING COSTS



# EVANS LIGHT WEIGHT

## TOROIDAL METAL REELS

### 25% AVERAGE WEIGHT SAVINGS PER REEL

Toroidal design helps cut weight and freight costs to a minimum. Permits easier, faster, lower cost handling.

### OUTLASTS 5 WOOD REELS

Evans metal reels have a proven service life of 20 reel trips. Many thousands of these reels have *lasted over 50 trips.*

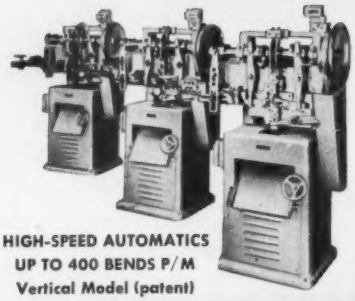
### CUTS MAINTENANCE COSTS

Cost records show Evans reels effect a 50% savings over wood . . . when Evans special repair kit is employed.

**For more complete information write to Chicago Sales Office: 208 South LaSalle Street.**

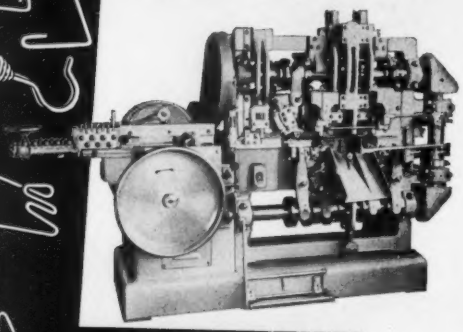
THE GEORGE EVANS CORPORATION
MOLINE, ILLINOIS

60 Jahre GREFE

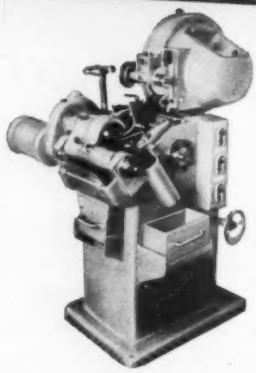


HIGH-SPEED AUTOMATICS
UP TO 400 BENDS P/M
Vertical Model (patent)

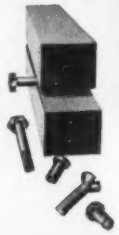
BENDING MACHINES UP TO
12 BENDING OPERATIONS



Coat Hanger Automatics New Model



ALL TYPES OF
THREAD ROLLING
DIES



COLD THREAD ROLLING MACHINES
SCREW-HEAD SLOTTING MACHINES

H. RICHTER

Please ask for inspection of machines recently supplied to North American customers

Please submit samples or drawings of articles you contemplate to manufacture.

SOLE REPRESENTATIVE FOR CANADA

**PAUL REICHER-MACHINERY & EQUIPMENT**

P. O. BOX 127 WILLOWDALE ONTARIO, CANADA

**LUDWIG GREFE MACHINEFABRIK**

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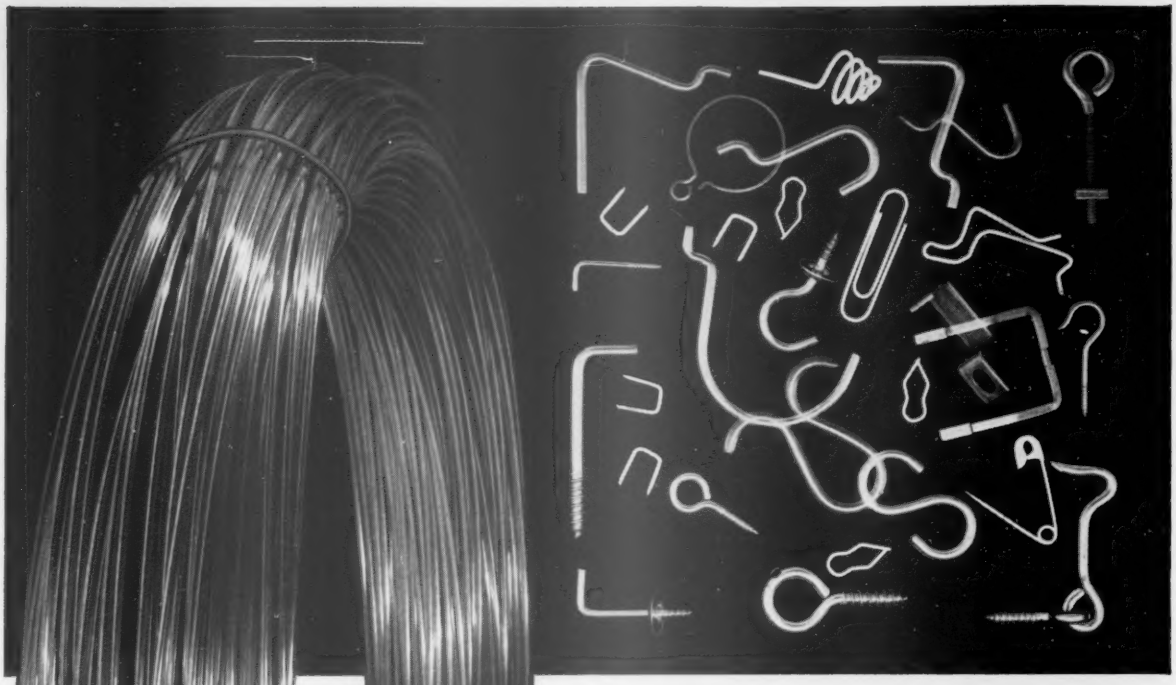

# FABRICATE PARTS

*easier, faster, better with*

# UNITED WIRE

When specs are tough, requirements rigid, savings essential, fabricate your parts with United Wire . . . aluminum, brass and copper alloys including 10-12-18% nickel silver. Here are the big important things you'll find in United Wire:

- Commercially bright — reduces finishing cost after forming.
- Tolerances — drawn or shaped to your most exacting standards.
- Temper — uniform throughout, every order, every time.
- Uniform coils — for trouble free pay-off.
- Size and shape — available in most sizes and shapes — round, square, flat and half-round.

Your "Wire Forms" can be fabricated easier and better at high speed production with low or no scrap loss by using "United" round or shaped wire.

UNITED WIRE AND SUPPLY CORPORATION

PROVIDENCE 7, RHODE ISLAND

ALUMINUM, BRASS, COPPER WIRE AND TUBE - BRAZING ALLOYS AND FLUXES

**Plan to visit Booth 1142 at the Cleveland Metal Show, October 27-31.**

# EVERY DIE NEED
# And Service at ONE Company
# 36 Years in one line . . . . .

***TUNGSTEN CARBIDE***

- **WIRE DIES**
- **BAR and TUBE DIES**
- **SHAPE DIES**
- **COLD HEADING DIES**
- **MANDRELS and PLUGS**
- **DIE RECUTTING SERVICES**
- **DIE MAKING MACHINERY**

***DIAMOND***

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- **DIAMOND POWDER**
- **DIAMOND LAPPING COMPOUND**
- **DIAMOND RECLAMATION**
- **DIAMOND DIE RECUTTING SERVICE**
- **DIE MAKING MACHINERY**

*DEPENDABILITY, EXPERIENCE . . . Your guarantee of products that will do the job for which you buy them.*

# UNION WIRE DIE CORP.

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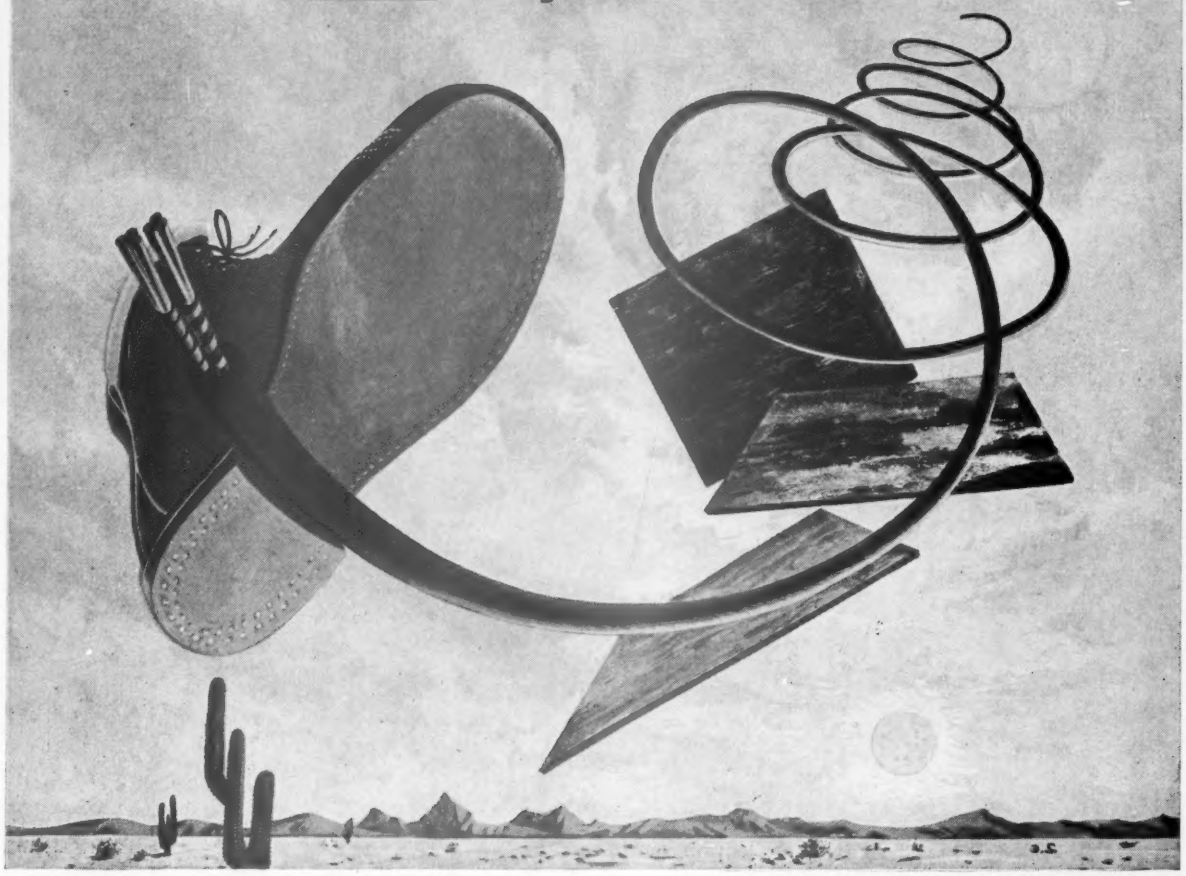
# NAUGAPOL K-50

SPECIALLY-PROCESSED SBR POLYMER

...a new dry rubber blend



Now a new dry rubber blend has been added to the Naugatuck line to give you a still wider choice of "wire grade" rubbers to meet your product needs.

A special masterbatch of high styrene resin and low-temperature polymerized synthetic rubber, Naugapol® K-50 offers unusually good processing characteristics together with the "dryness" and high-cured physicals for which all Naugapols are noted.

Primarily designed for use with additional butadiene-styrene copolymer—for such products as shoe soles, floor tile, and wire insulation—Naugapol K-50 is the only blend of this kind available which is suitable for wire insulation.

Try Naugapol K-50—available in pellet form—wherever you require high dielectrics, low-ash, easy processing. For detailed information on Naugapol K-50, the Naugapols generally, or still other special grades of synthetic rubber, write us today.

**Naugatuck Chemical**

**Division of United States Rubber Company**

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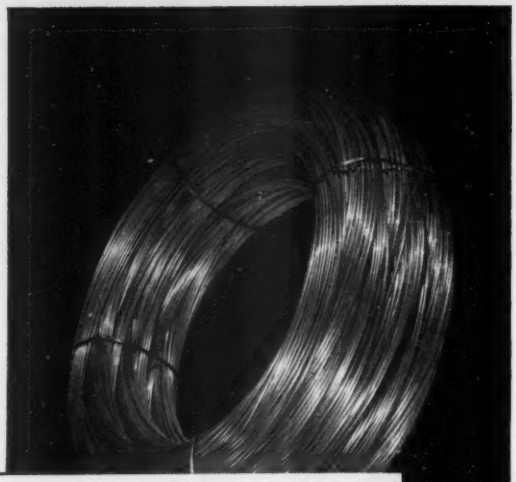
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario • CABLE: Rubexport, N.Y.

**"Tough-to-make"**

**Cold-Headed Products like these . . .**

- Tubular Rivets (Punch Extruded).
- Non-threaded, multi-diameter, head and shoulder parts, drilled or not drilled.
- Washer and binding head screws with rolled threads.
- Special design fastenings and other small parts of intricate shape, with or without requirements for drilling or threading.

**. . . become "routine" with**



**SCOVILL**

EXTRUDED

# Cold-heading WIRE

(Cartridge Brass, 70%)

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

## IT ELIMINATES

1. **OUT-OF-ROUND HEADS**
2. **INCOMPLETE FILLING-OUT OF HEADS AND SHOULDERS**
3. **ROUGH "ORANGE PEEL" EFFECT**
4. **UNSOUND HEADED PARTS**
5. **RED STREAKS AND STAINS**
6. **NON-UNIFORM FLOW**

**SCOVILL**

Send for new folder.

Scovill Cold-Heading Wire is extruded from CONTINUOUS-CAST brass billets by the hot extrusion process, then cold-drawn and annealed in accordance with closely controlled mill procedures.

CONTINUOUS CASTING produces *more uniform metal* than any other process, both in chemical composition and in freedom from casting flaws or other variations.

Scovill has standardized on *Cartridge Brass*, 70% for wire to be used in cold-heading operations. This alloy has a 5% HIGHER COPPER CONTENT than is generally found in brass cold-heading wire and is more ductile.

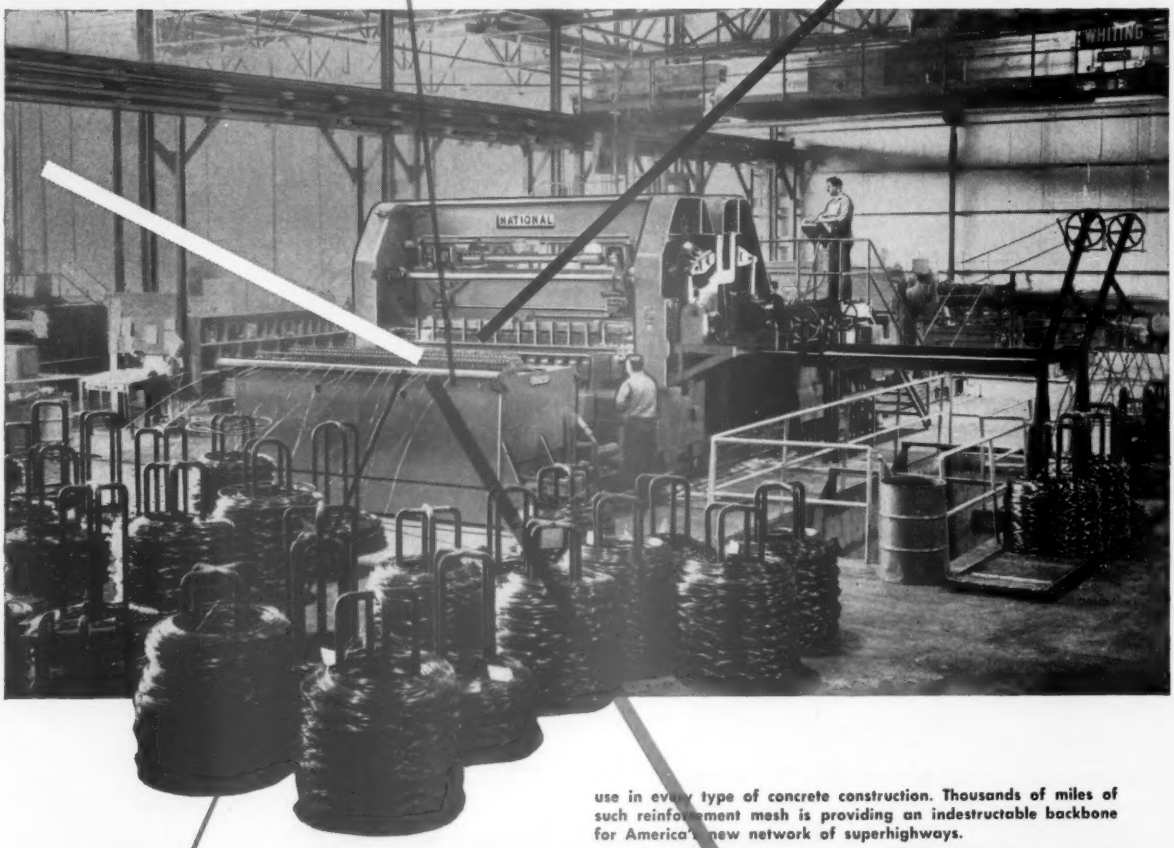
Prove this on your next wire order. Let us help you specify the proper closely controlled Scovill temper to produce more nearly perfect headed brass parts . . . whether you require "flow" characteristics for heading, or "flow" plus essential rigidity for secondary machining.

**SCOVILL MANUFACTURING COMPANY, Mill Products Division**

99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

129C50

# this NATIONAL ELECTRIC UNIT is a completely automatic high speed wire mesh manufacturing plant




Starting with coils of line-wire, this National Electric Wire Fabric Welder automatically turns out welded wire mesh in a variety of sizes . . . and at surprising speeds. In a single hour, as much as 250 miles of wire is transformed into high-quality wire mesh for all kinds of uses including reinforcement in concrete construction, fencing, etc.

Beginning at a line wire straightener unit, each wire is passed over as many as 10 grooved, staggered rollers for straightening.

Next, the line wires pass over welding dies within the machine's welding unit. Here, under a pressure of 60,000 lbs., a mat as wide as 200" is welded at each junction-point, the cross-wires being fed in automatically, at whatever spacing may be indicated by the reciprocating indexing-platen.

The machine next shears rectangular mats to the required size or winds welded fabric into coils of desired length. Finished coils are automatically discharged onto a ramp . . . rolling away to the loading dock or warehouse.

The rugged, steel-mill design and construction of this machine makes it possible to efficiently weld as many as 120 cross-wires per minute. Since 1945, National Electric Wire Fabric Welders have been dependably turning out welded wire mesh in numerous sizes, for use in every type of concrete construction. Thousands of miles of such reinforcement mesh is providing an indestructable backbone for America's new network of superhighways.

Complete automation, the key to profitable production, is made possible in National Electric Welding machines by means of utilizing automatic feeds, radial feeds, automatic positioners, multi-head design, automatic discharge devices, motor-driven rotating fixtures and sequenced ejectors. By their speed and accuracy, National Electric machines achieve amazing savings in time, labor, and cost-per-weld.

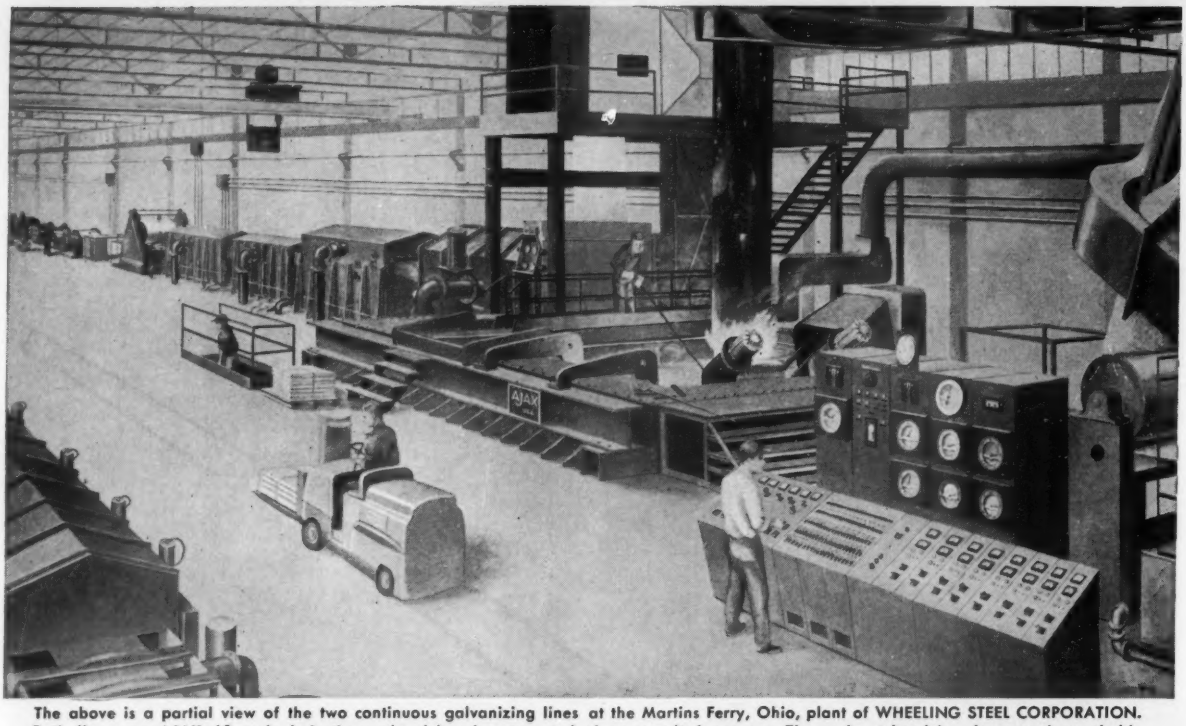
Write today for complete information on National Electric Automatic Wire Mesh Welders or any other special or standard welding problem that you may have.

50

# NATIONAL
## ELECTRIC WELDING MACHINES CO.

1880 N. TRUMBULL STREET
BAY CITY, MICHIGAN

25 YEARS EXPERIENCE DESIGNING AND BUILDING: SPECIAL & STANDARD • AIR • HYDRAULIC • MOTOR DRIVEN • SPOT • PROJECTION • SEAM • BUTT • FLASH • RESISTANCE WELDERS • PRODUCTION FIXTURES FOR ALL TYPES OF AUTOMATIC ARC WELDING.




The above is a partial view of the two continuous galvanizing lines at the Martins Ferry, Ohio, plant of WHEELING STEEL CORPORATION. Both lines use AJAX 60 cycle induction galvanizing furnaces and zinc premelt furnaces. The main galvanizing furnace shown holds 175 tons of zinc, is rated 2000 kw, and produces over 40 tons per hour at speeds in excess of 300 feet per minute. These continuous galvanizing lines produce WHEELING's patented SOFTITE sheet.

# 60 Cycle induction galvanizing

has progressed from small beginnings a few years ago to a present capacity of well over **one million tons per year.**

Here is an entirely new approach to an old art:

1. A refractory lined hearth in place of the iron kettle eliminates kettle replacement and iron pickup, drastically reduces dross formation.
2. Temperature control is precise, lag free, holds the melt at ideal galvanizing temperature at all times.
3. Gentle electromagnetic circulation facilitates alloy additions, keeps alloy uniform throughout the melt.
4. Clean and cool working conditions for hand dipping or continuous operations.

All these factors help to produce a galvanized coating of consistent superior quality and to attain high production at lowest unit costs.

MAY WE HAVE YOUR INQUIRY?

AJAX USA

## ENGINEERING CORPORATION

TRENTON 7, NEW JERSEY

60 CYCLE INDUCTION MELTING

Associated Companies: Ajax Electrothermic Corporation Ajax Electric Company

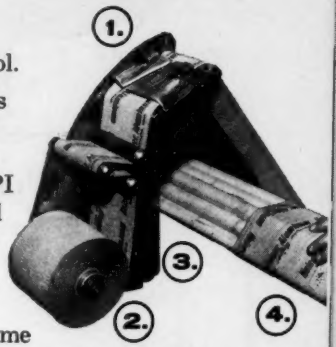
# New Spiralwrap Machine Handles Coils up to 82" O.D.

Ludlow's new UW-16 Spiralwrap Machine offers a greater coil size capacity than any other machine of its type. With a coil traverse of 15½", the UW-16 wraps coils from 24" to 82" O.D.

The UW-16 is *custom designed* to meet your exact range requirements. Conformation of the machine to the product is achieved by simply "dialing" the coil specifications.

Bottom-wrap design permits wrapping of both heavy and lightweight coils with a tight, safe wrap. The larger capacity of the machine permits larger rolls of paper, minimizing stops for paper loading. The UW-16 is the first machine designed especially for the extreme size of coils now required by industry.

The UW-16 joins a complete line of Ludlow spiral-wrapping equipment. Spiralwrapping machines now range in gap width from 4" to 16" . . . Accessories include a variety of special devices and papers as indicated below:




**1.** DEVICES for folding, edging and tension control.

**2.** CREPED WRAP includes regular and waxed kraft, asphalt and non-staining laminated, reinforced, VPI and non-asphaltic neutral (for anti-rust), and polyethylene coated or laminated.

**3.** PRINTED with your name or trademark in one or more colors if desired.

**4.** RODS and straight lengths as well as coils can be wrapped better at less cost on Ludlow spiralwrap machines.

When writing for information, be sure to describe the nature and dimensions of the product you wish to wrap. Trained Ludlow technicians are always available for an on-the-job analysis of your packaging problems.

**SPECIFICATIONS: UW-16 BOTTOM WRAP MACHINE**
**POWER:** 220V/440V, 3 Phase, 60 Cycle Standard wiring
**SAFETY FEATURE:** 110V controls • **SHUTTLE MOTOR:** 1½ h.p.
**FEED ROLL MOTOR:** ½ h.p. • **GUIDE ROLL MOTOR:** ½ h.p. with reduction gear • **HEIGHT:** 126½" (based on 82" O.D. coil)
**BASE:** 66" wide x 44" long • **WEIGHT:** 3600 lbs. • **PAPER ROLL SIZE:** 14" diameter x 5" wide; 1⅞" core • **MAX. WRAPPING CAP. PER ROLL:** 82" O.D. coil (62" I.D. x 15" Traverse)

*See us at the Show — Oct. 13-16*
*Suite 409 — Chalfonte-Haddon Hall Hotel*
*Atlantic City, New Jersey*

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**NEEDHAM HEIGHTS 94, MASS.**

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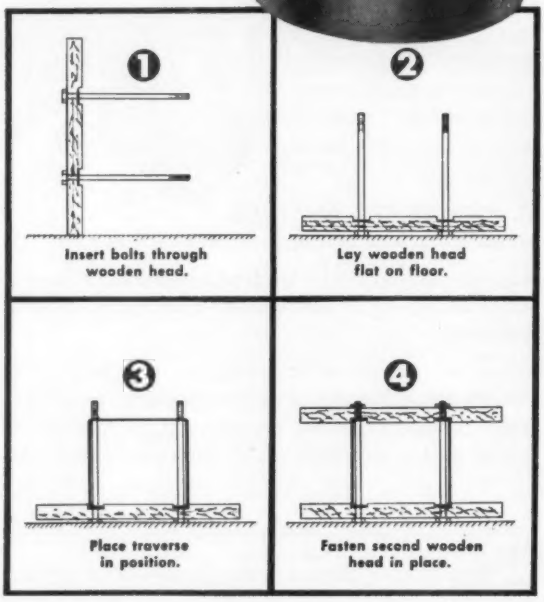
## Assemble it — Forget it

# SAVE *Time Labor Money*

## REPUBLIC FLANGED STEEL TRAVERSES




**SAVE TIME**...Simple 4-Step Reel Assembly

**SAVE LABOR**...No Special Tools, Lightweight Construction

**SAVE MONEY**...Long, Trouble-Free Service

**SAVE SPACE**...Stack and Store in a Minimum Area

Republic Steel Traverses are reinforced where it really counts—at flange base and bolt holes. Makes possible the use of lighter gage steel. Reduces unit weight 20%. You get the highest strength-to-weight ratio attainable.

Three different finishes—plain, painted, and hot dip galvanized—meet all cable requirements. Flange width and bolt and drain holes can be furnished to your specifications.

Choose from industry's most complete line. Over 100 sizes ranging from 12" to 56" diameters and 6" to 48" lengths. All available for quick delivery. The coupon below will bring complete information.

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Send more information on Flanged Steel Traverses.

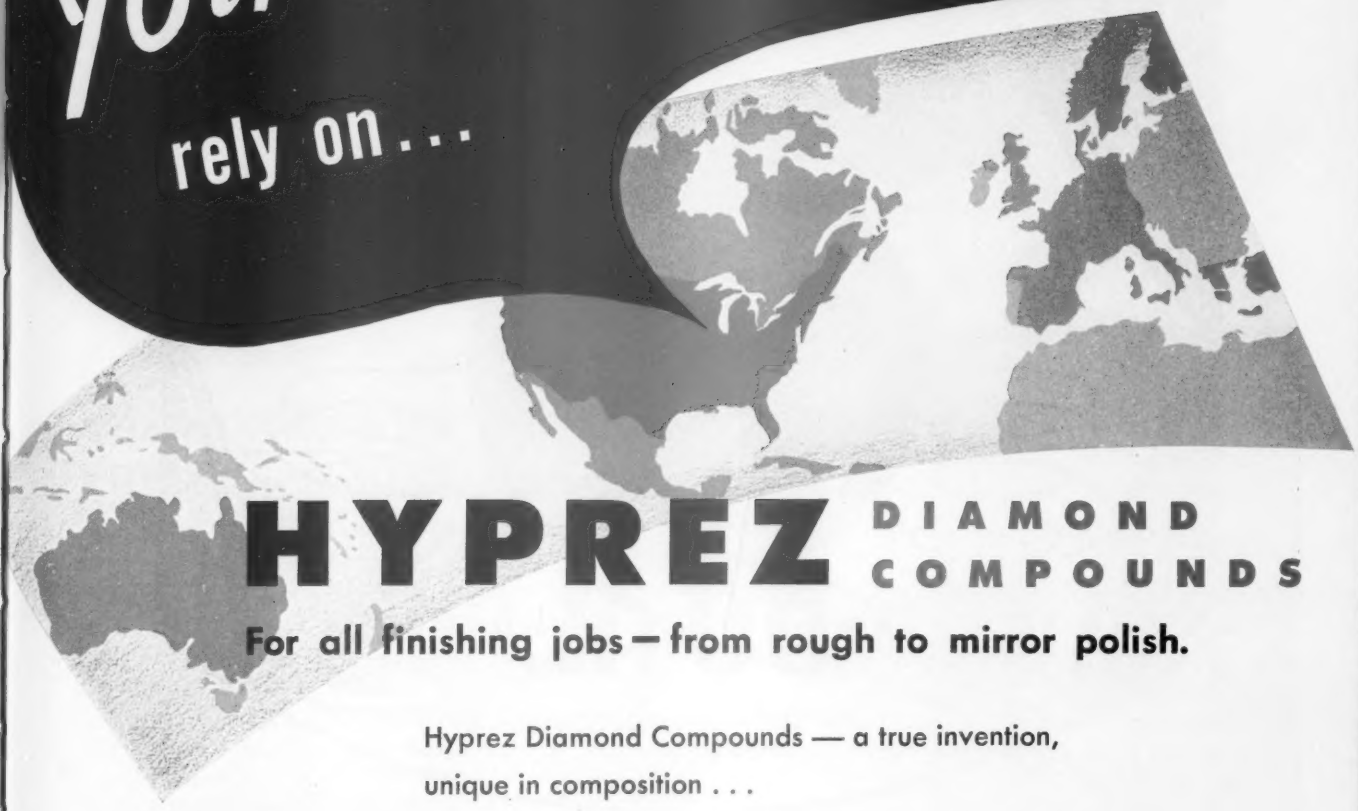
Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

# You and the world's industries rely on...



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**For all finishing jobs — from rough to mirror polish.**

Hyprez Diamond Compounds — a true invention, unique in composition . . .

- Are used in 19 foreign countries, in addition to the United States and Canada.
- Are patented in Switzerland, Sweden, Great Britain, and France.
- Are manufactured under exclusive license in Great Britain, Switzerland, and France.

This worldwide acceptance — the result of 15 years of research and rigid quality control — is guarantee that Hyprez will do your finishing job best.

**HYPREZ**, the original Diamond Compound, is available in types and grades for every finishing requirement; in 18- and 5-gram sealed cartridges for use with the Hyprez Applicator Gun.

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**ENGIS EQUIPMENT COMPANY**
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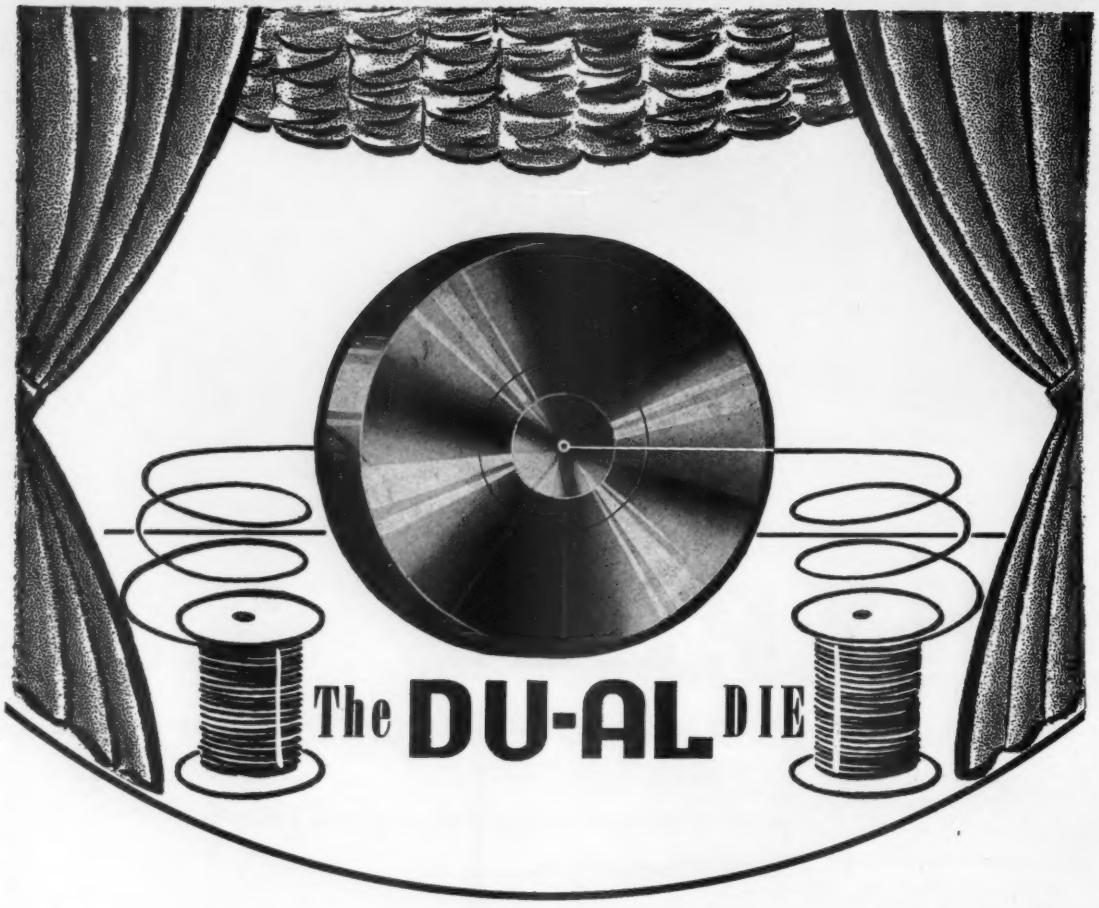
Laminor S.A., Annecy, France

# INTRODUCING




Once again the Indiana Wire Die Company, as the leader of the diamond die industry, has made an advance in diamond die production. Now you can obtain for your wire drawing needs a diamond die that accomplishes all that the old-fashioned ordinary die could do plus much more. I.W.D.C.'s new "Du-al" die, because of the fine workmanship and quality of material contained in it, does the job of the regular diamond die more efficiently. However, it also has some extra-special features of its own that make it a must for you. Not only does it fill the role of regular one-way die but it can also be used as a reversible or two-way die.

All of this is important but the most important feature of the "Du-al" is that it comes wih two separate and usable drawing angles. For more information on this unusual addition to Indiana's fine quality products, write to:

**INDIANA WIRE DIE CO.**

HARRISON 4373

314 E. WALLACE STREET
FORT WAYNE, INDIANA

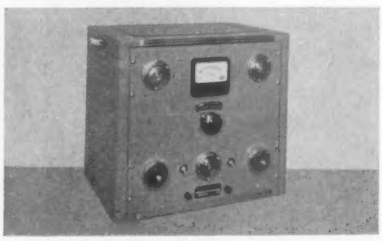
*When in Rhode Island, visit our new, modern, air conditioned factory at 100 Glen Road, Cranston.*

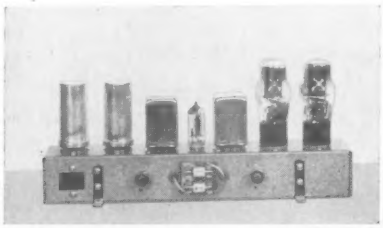
# SPARK TESTING HEADQUARTERS FOR THE WHOLE WORLD OF WIRE!

Over the past twenty years, the world standard for the Spark Testing of wire has been the principle and method conceived and introduced by the James L. Entwistle Company.

Today, our new developments of "Controlled Power"*, Positive Electronic Fault Location*, and "Fog-Bank" Electrode Units* make all previous methods obsolete, and bring efficiency to the highest peak yet known!

Isn't it logical then, when you have Spark Testing problems, to consult the firm that originated the Standard of the World?





*Left, Above: Competition Grade, Economy Line Spark Tester, Class K, A.C., Class M, D.C. Normally furnished with series-type fault location circuit, but available with high speed, high sensitivity plug-in fault location circuit at extra cost.*

*Right, Above: New Plug-In Electronic Fault Detection Circuit, standard and identical on all JLE Standard Grade, Super-Quality Spark Testers. Easily replaced if fault circuit fails or does not come up to speed or sensitivity standards on calibration.*

*Above: Class J, A.C., Class D, D.C., JLE Standard Grade, Super-Quality Spark Tester and Printing Recorder. Vertical, space-saving model requiring only 18" x 22" of floor space. Designed particularly for use on plastic extruding or rubber C.V. lines, with remote mounting of Electrode Unit.*

- A.C. AND D.C. "CONTROLLED POWER"* SPARK TESTERS
- COMPLETELY AUTOMATIC RE-REELER-SPARK TESTERS
- HIGH SPEED, 5,000 F.P.M., 1½ LB. TENSION RE-REELERS
- AUTOMATIC DOUBLE-HEAD COILER SPARK TESTERS
- "FOG-BANK" ELECTRODE UNITS*
- PRINTING-TYPE FAULT AND REEL RECORDERS
- OPEN-SIDE MEASURING MACHINES
- SHAFTLESS TAKE-UPS • PAY-OFF REEL STANDS
- BALL BEARING WORM TRAVERSES
- "JET-STREAM" SPIRAL STRIPING MACHINES*
- WIRE MARKING WHEELS, TYPE STRIPS AND INKS

*** Complete Patent Protection Applied For**

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## James L. Entwistle Co.

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MAILING ADDRESS, P. O. BOX 3674

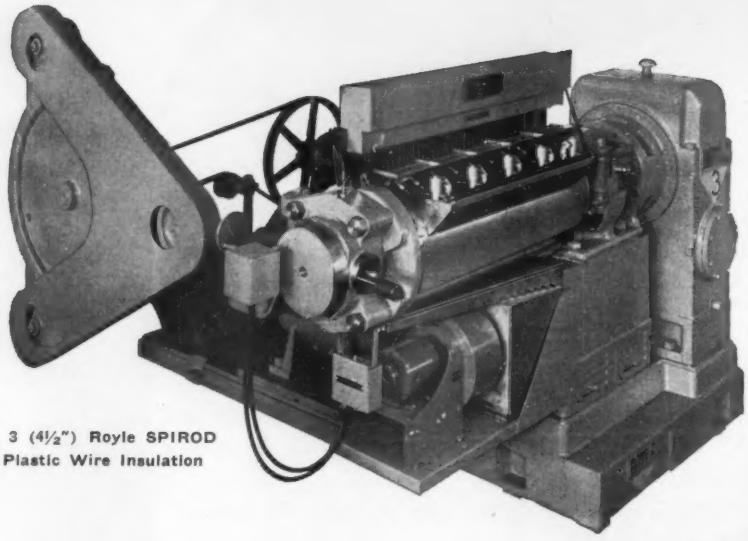
Cable "JALENCO" Providence, Phone Hopkins 7-8411

**ENGLAND**

**General Engineering Co. (Radcliffe) Ltd.**
**Station Works — Bury Road**
**Radcliffe, Lancashire, England**

# ROYLE SPIROD®

## ● FOR MAXIMUM VERSATILITY



No. 3 (4½") Royle SPIROD
for Plastic Wire Insulation

● Whether you are extruding plastics that require high processing temperatures or quick-curing compounds Royle Spirod—the all purpose, all-electric, completely automatic extruder—provides positive temperature control. This versatility is the result of combining a proportioning controlled system of high velocity evaporative cooling with tubular resistance heating to supply constant, accurately zoned processing temperatures.

● Send for Bulletin #463

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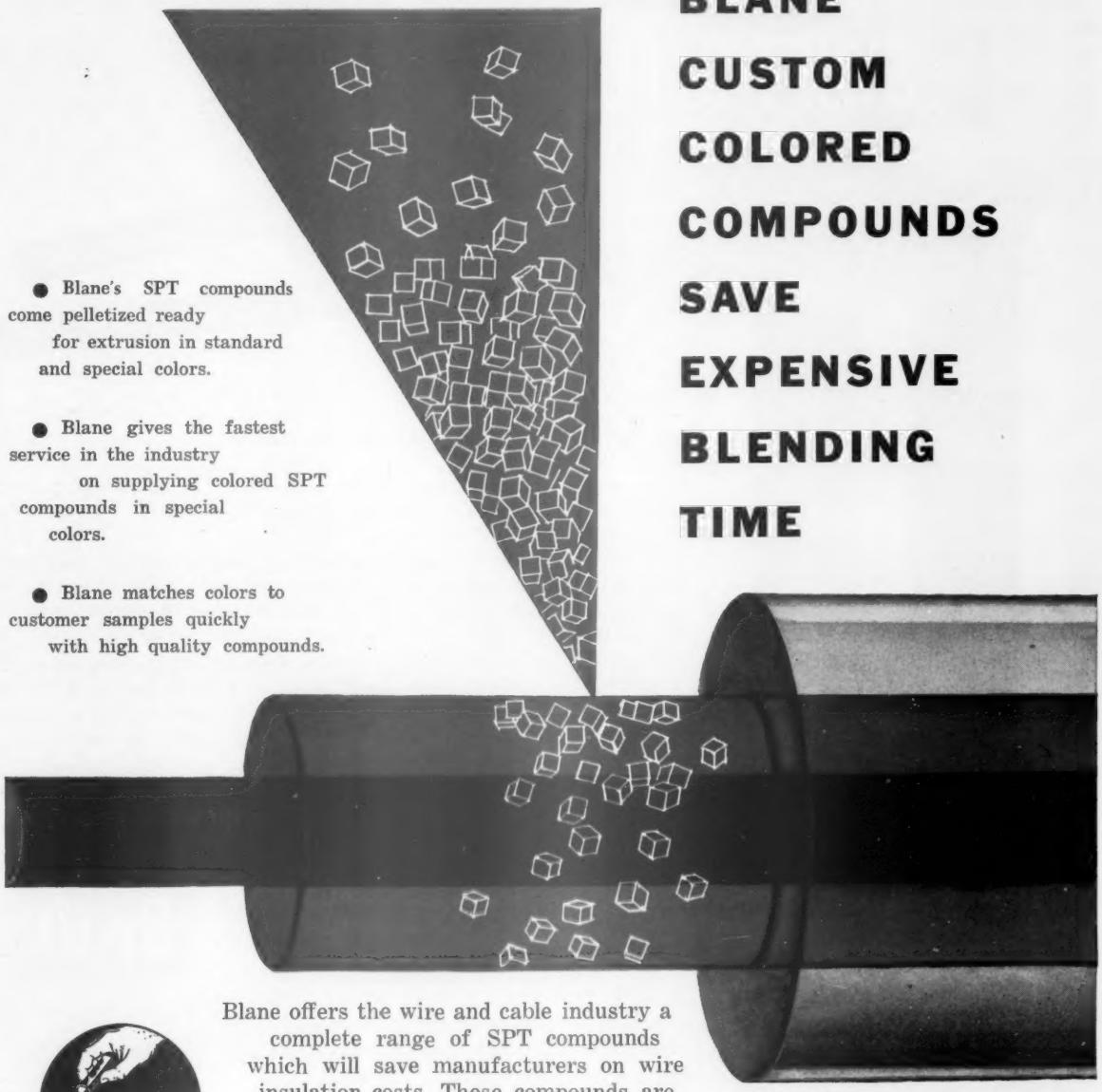
# BLANE
# SPT
# COMPOUNDS

**BLANE CUSTOM COLORED COMPOUNDS SAVE EXPENSIVE BLENDING TIME**



- Blane's SPT compounds come pelletized ready for extrusion in standard and special colors.
- Blane gives the fastest service in the industry on supplying colored SPT compounds in special colors.
- Blane matches colors to customer samples quickly with high quality compounds.

Blane offers the wire and cable industry a complete range of SPT compounds which will save manufacturers on wire insulation costs. These compounds are designed to meet UL requirements. And Blane laboratory specialists are ready to assist you on any color problem. Write for samples, technical data, and prices.

## THE BLANE CORPORATION

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# SWIFT'S FLEXAL 2

THIS "LIGHT" METALLIC STEARATE WAS THE

*MISSING LINK* IN AN IMPORTANT DEVELOPMENT

## Your process might be the next to benefit

Until recently, Flexal² was the elusive *missing link* in a Swift research program aimed at the development of a superior and highly heat resistant, water insoluble, metal processing lubricant.

Flexal² is a "light" metallic powder of extremely uniform consistency. It has exhibited excellent heat stability and has shown long, effective and *economical* service life as an anti-friction agent for the processing of ferrous metals.

Swift's success with this program has revealed a *variety* of usages for Flexal² which has led to the development of a whole *family* of Flexals. The properties offered by this new family of products will be of interest to anyone seeking a: *process lubricant; parting agent; high speed and/or anti-friction compound . . . and many others.*

The Flexals are available in production quantities or on sample or trial order. The benefit of Swift's technical experience with these remarkable products is available to help you. Just return the coupon for details.

*To Serve Your Industry Better* **Swift** 103RD YEAR

**FREDDIE FLEXAL** *invites your further inquiry.*

SWIFT & COMPANY, Industrial Soap Dept. S-44W
4115 Packers Ave., Chicago 9, Illinois

How can we place a trial order or obtain a sample of Swift's Flexal?

(Please describe intended usage briefly) .....

.....

Company .....

Address .....

City ..... Zone ... State .....

Your Name & Position .....

## Youngstown rope wire

### *will help speed construction in his day*

New schools for a burgeoning population—super highways of greater breadth and width—modern plants that serve whole nations—these are only three of the millions of new construction projects this boy will see completed with the assistance of wire rope fabricated from Youngstown wire. Continuing advancements in research and steelmaking facilities make certain that when the buildings of *his* day rise into the sky ... *Youngstown Rope Wire will help construct them.*

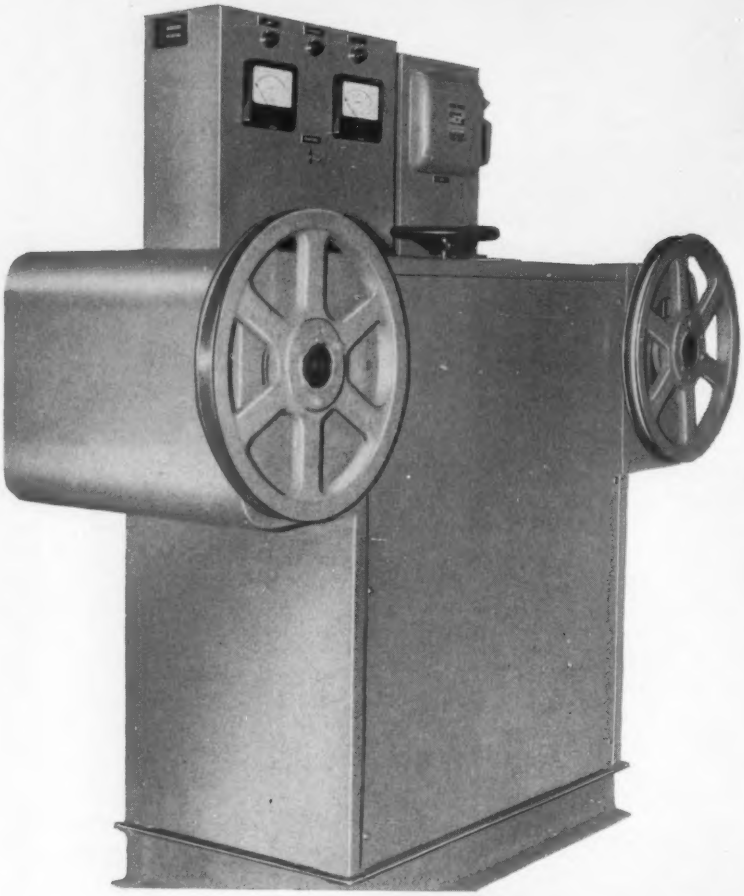
THE
**YOUNGSTOWN**
SHEET AND TUBE COMPANY

*Youngstown, Ohio*

*Manufacturers of Carbon, Alloy and Yoloy Steel*

THE FEDERAL MANUFACTURING CO. WALLINGFORD, CONN.

WIRE MACHINERY • TESTING EQUIPMENT



# WIRE PREHEATER BY FEDERAL

Made in five popular models—
3, 5, 10, 15, & 30 KW.
Larger units made upon request.

With FEDERAL PREHEATERS, there is less wire drag.

No burning of wire when starting or stopping.

For better wire coating, use FEDERAL PREHEATERS in your extrusion lines.

★ ★ ★

## OTHER FEDERAL MANUFACTURING CO. PRODUCTS

Payoffs - Takeups - Capstans - Re-Spoolers - Patching Moulds
Preheaters - Measuring Machines - Payoffpak - Coiling Machines

## TESTING EQUIPMENT

### FOR INSULATED WIRE

★ Dielectric A.C. or D.C. and Electronic

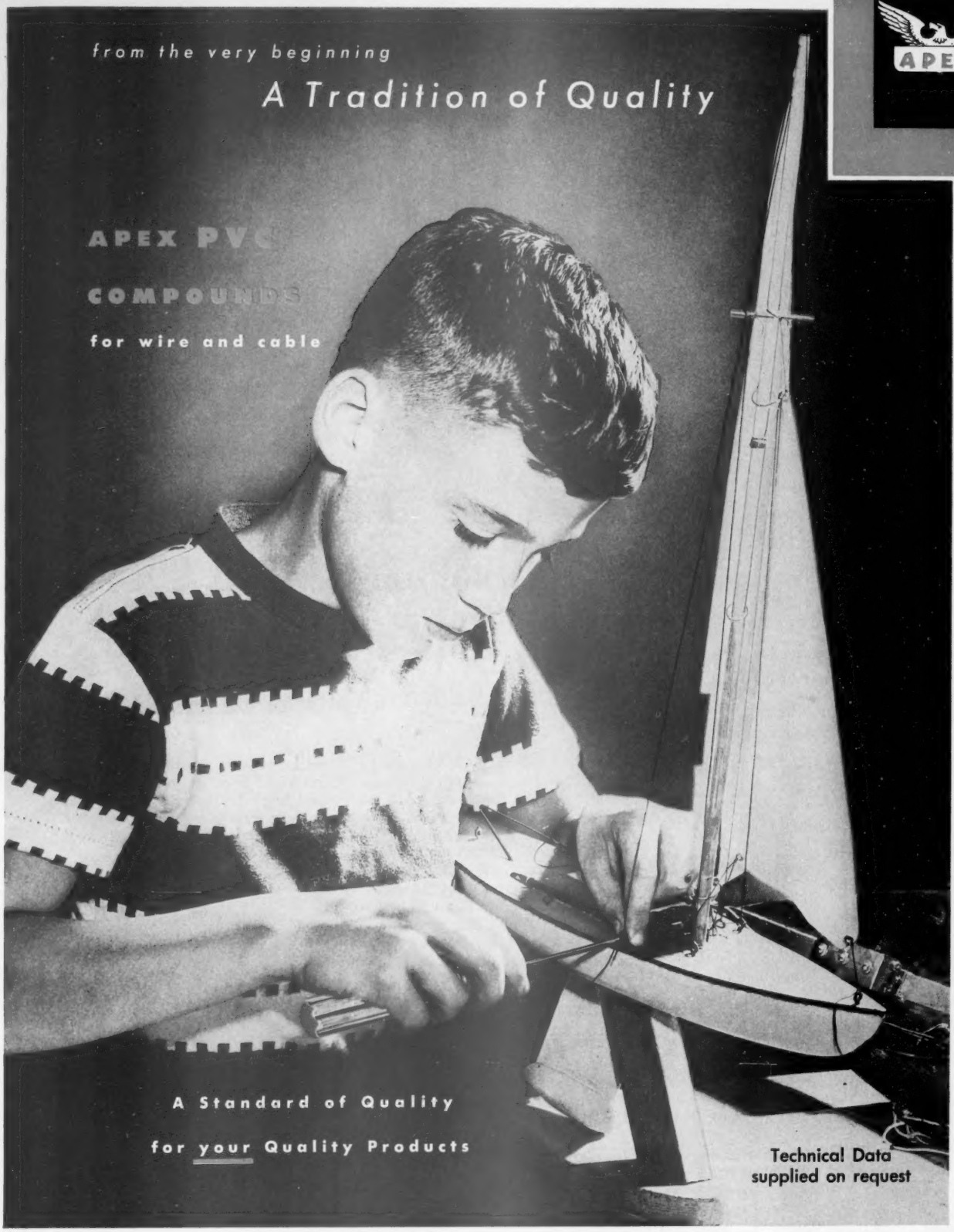
★ High Potential

### FOR ENAMELED WIRE

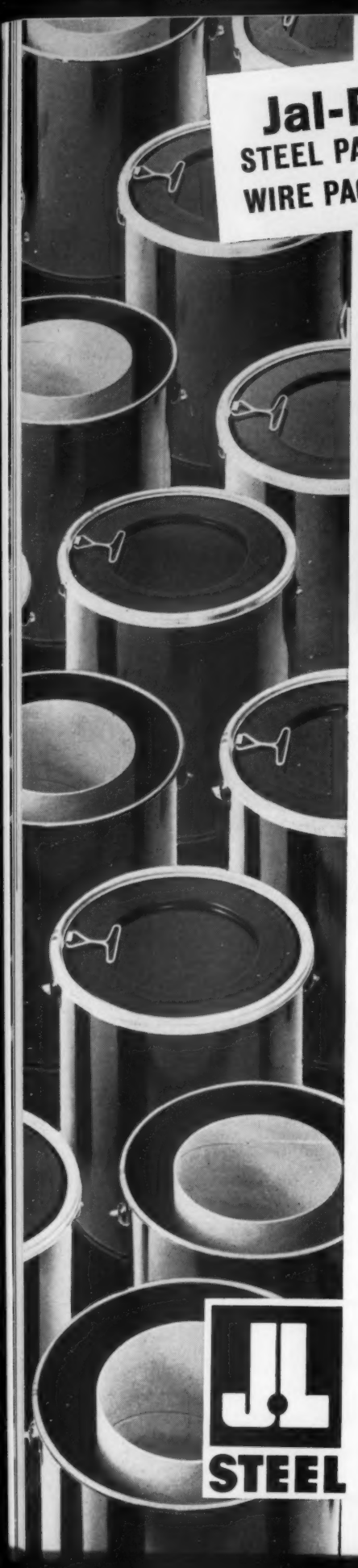
★ Dielectric

★ Abrasion Scrape

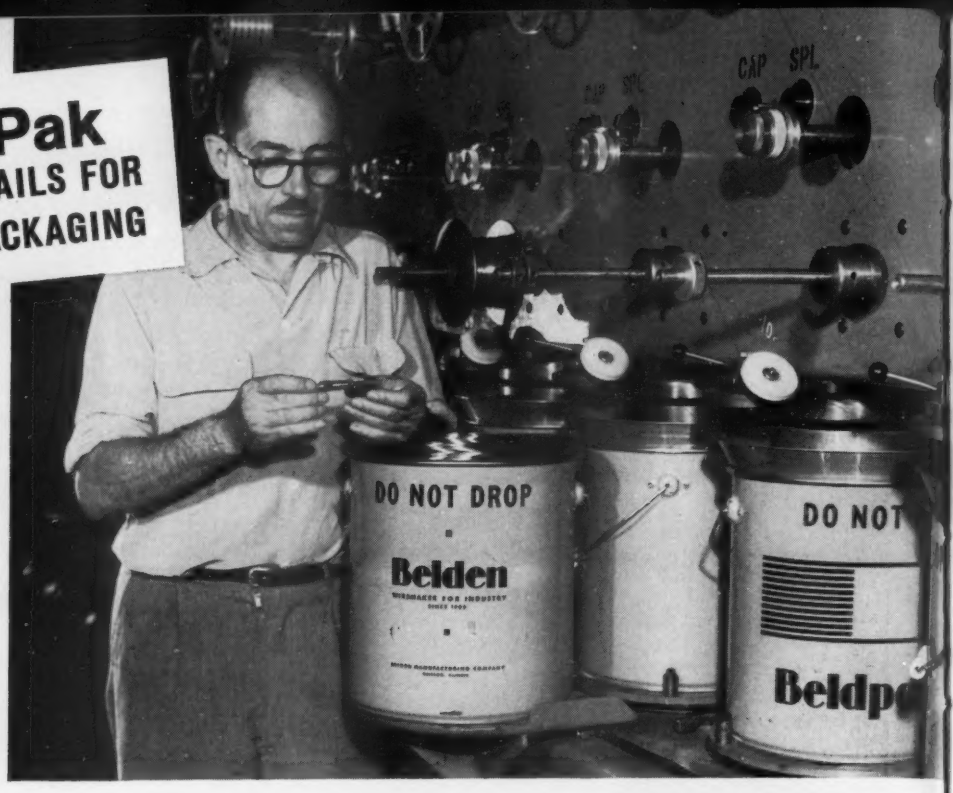
★ Continuity




**APEX TIRE & RUBBER CO.** Plastics Division **Pawtucket, R. I., U. S. A.**



**Jal-Pak**
**STEEL PAILS FOR WIRE PACKAGING**




# "J&L DISPOSABLE PAIL CUTS OUR WIRE HANDLING COSTS"

## ...states Belden Manufacturing Company

"These Jal-Pak pails eliminate costly spools and reels in wire handling," reports the Belden Manufacturing Company, Chicago. "There is no initial spool investment, return problem or involved bookkeeping." Belden uses the name Beldpak for Jal-Pak pails. They use them for 14 to 30-gauge wire in 100 pound quantities.

Jal-Pak pails, a unique Jones & Laughlin product, feature a specially rolled smooth side seam that prevents damage to wire and permits optimum winding speeds. You get the protection of steel in shipment and storage. The lower investment, no deposit, no return, save time and money in production operations.

Jal-Paks are service-proved in handling brass, copper, steel, aluminum, stainless steel, welding and soldering wires. For complete information on how Jal-Paks can help you increase production and sell more wire, contact your J&L Container Division representative or write direct to Jones & Laughlin Steel Corporation, 405 Lexington Avenue, New York 17, N.Y.

Belden Manufacturing Co., Chicago, utilizes machines that can handle 24 wires in four sizes with two coats of insulation and simultaneously reel them into 12 rotating 100-lb. Jal-Pak pails. No spools or reels are required.

**Jones & Laughlin Steel Corporation**
**CONTAINER DIVISION**
405 LEXINGTON AVENUE, NEW YORK 17, NEW YORK

J&L STEEL

*Greetings* . . . . . ALL MEMBERS
AND GUESTS OF **THE WIRE ASSOCIATION**

# WE ARE PROUD OF THE COMPANY(S) WE KEEP (*happy that is...*)

KENNECOTT WIRE AND CABLE
UNITED STATES STEEL
MID-STATES STEEL AND WIRE
KAISER ALUMINUM
BELDEN MANUFACTURING COMPANY
BRIDGEPORT BRASS
CONTINENTAL STEEL
INTERNATIONAL NICKEL
BRODERICK AND BASCOM ROPE COMPANY
STEEL COMPANY OF CANADA
SIMPLEX WIRE AND CABLE
LACLEDE STEEL
BETHLEHEM STEEL
B. GREENING WIRE COMPANY
JONES & LAUGHLIN
NEHRING ELECTRICAL WORKS
B. F. GOODRICH COMPANY
COPPERWELD STEEL
AMERICAN CHAIN AND CABLE

. . . AND MANY OTHERS

Our roster of distinguished users of Micro-Welders reads like the Blue Book of American Industry.

## *Ask* THE FIRMS WHO USE MICRO-WELDERS

. . . for continuous butt welding of ferrous wire, sizes .005″ to 1.250″

. . . for continuous butt welding of non-ferrous wire, sizes .010″ through 1.000″. . .

They will tell you that Micro-Welders are

- **Easy to Operate**
- **Durable**
- **Economical**

MICROMETER PRECISION — MICRO-WELD — TRADE MARK REGISTERED

**OUR 30 YEARS OF EXPERIENCE IN THIS HIGHLY SPECIALIZED FIELD ARE AT YOUR COMMAND . . .**

# MICRO PRODUCTS CO.

**MODEL S.E.M.T.**
For Welding All Types of Fine Wire Aluminum, Copper, Brass, Bronze, Steel and Steel Alloys, sizes .005″ to .020″

**Model S. E. M. T.** is equipped with a temperature-indicating device for annealing and tempering, voltage regulator and meter to compensate for voltage fluctuations, wire cutters, extra large magnifying glass, fluorescent light and extension cord. Can be supplied for bench-mounting or mounted on 4-wheel truck.

**Model A. C. M. T.**, similar in design, covers capacities from .010″ to .062″.

20 NO. WACKER DRIVE
CHICAGO 6, ILLINOIS
TELEPHONE STate 2-7468

# Burroughs' Unique Tests and Johnson Wire Build Quality, Long Life in Business Machines

## Detroit Plant Develops Own Devices For 100% Tests of Music Wire Springs

Burroughs Corporation demands music spring wire as thin as a spider web's strand but with a minimum tensile strength of 439,000 pounds per square inch.

Then—to make sure it gets what it orders—the Detroit business machine manufacturer does 100 percent testing of all wire coming into its plants. Burroughs goes further than standard test equipment would permit and has developed its own special testing devices.

Burroughs' insistence on enforcing specifications is the kind of quality challenge on which Johnson Steel & Wire Company thrives. A customer's emphasis on quality wire complements Johnson's own skill and care given to producing the best in specialty fine wires.

**Precision springs,** made from Johnson Steel & Wire Company's music spring wire, get 100 percent testing on unique testing machines like this. Designed and built by Burroughs, this machine verifies a spring's load-carrying capacity at various extensions. If any modification is needed, correction can be made while spring is still on test device.

**Johnson Steel & Wire has become Burroughs' major music spring wire supplier because Johnson's wire passes 100 percent inspection with flying colors.**

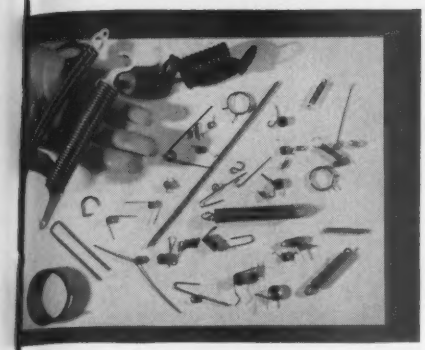
At Burroughs, where a monthly production of 3½ million precision springs of music wire is not unusual, close attention must be given to everything affecting performance of the finished spring. Failure of even the simplest spring could disable an adding machine, cash register, calculator or any of the dozens of different business machines Burroughs makes.

For its new machines, as well as service parts for older models, Burroughs makes 1,300 different kinds of springs. Music wire required for them ranges from .005-inches in diameter (with minimum tensile strength of 426,000 psi) to the largest diameter used—.106 inches in diameter, (with a minimum tensile of 268,000 psi).

Here's what Burroughs wants from music spring wire, in addition to tensile strength:

**The coating,** in the case of tin-coated music spring wire, must be uniform and adherent to eliminate peeling, cracking or flaking during coiling.

- **High physical qualities,** uniform cast and smooth, lustrous surfaces are another must so that uniform springs, within dimensions and capable of carrying assigned loads, can be produced.
- **Accuracy of dimensions** greatly affects spring coiling and spring performance. Burroughs' tolerance specifications are met consistently by Johnson's wire.
- **Straightness requirements** for pre-straightened wire call for a three-foot length of wire cut from a



**Here's some of the approximately 1,300 different kinds of springs which Burroughs Corporation manufactures from Johnson Steel's music spring wire.**

coil to be straight within 4 inches for .013-inch diameter wire and straight within 3 inches for wire .014-inch diameter and larger.

• **Coilability** is assured in the music spring wire Burroughs buys. Burroughs specifies that wire (.105 inch in diameter and smaller) must meet this test:

Wire is wound in a tightly closed spring to a coil length of 5 inches on an arbor 3 to 3½ times the diameter of the wire. When this spring is stretched so that it sets to 3 times its original length, the coils must show a uniform pitch with no splits or fractures in the wire.

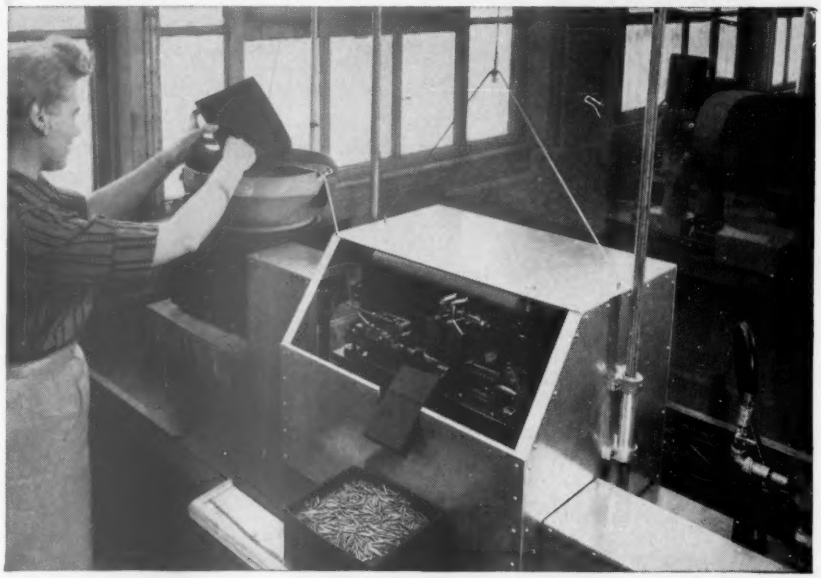
Testing completes the cycle which calls for highly skilled technicians coiling the best music spring wire available on the most modern equipment.

Testing machines, designed and built by Burroughs and used in addition to the standard machines, include the test fixture pictured here. This machine tests load-carrying capacity of springs. If any corrections are needed, they can be made while the spring is still on the test device.

Burroughs' careful attention to specs, its quality control and its testing procedure—plus its confidence in Johnson's music spring wire—are proof that Johnson can meet the toughest music wire demands.

Putting Johnson's music spring wire on your production lines starts benefiting you immediately. A corps of skilled wire engineers is as close as your telephone. Get in touch today with any of the district sales offices listed at right.

**Several hundred music wire springs** have been installed in this portable Burroughs adding machine. Every spring is critical, says Burroughs, because even the smallest spring failure could disable the machine.



**This automatic spring eye-forming machine** was designed and built by Burroughs personnel. An operator is shown filling the hopper with coiled springs which will be given an eye at each end on this device.

# Johnson Steel & Wire Company, Inc.

**Worcester 1, Massachusetts**

*a subsidiary of* **Pittsburgh Steel Company**

**Grant Building • Pittsburgh 30, Pa.**

**District Sales Offices**

| | | | | |
|---|---|---|---|---|
| Atlanta | Cleveland | Dayton | Los Angeles | Pittsburgh |
| Chicago | Dallas | Detroit | New York | Tulsa |
| | | Houston | Philadelphia | Warren, Ohio |

# PLASTICS *Granulators* for the

## PREPARATION OF PLASTICS FOR EXTRUSION AND MILLING

**Made by**

## ALSTEELE ENGINEERING WORKS, INC.

**ARE ALL THAT THE NAME IMPLIES**

A complete line of Hi-Power, Heavy Duty, Water Cooled Grinders for Plastics constructed of Heat Treated Steel and Forgings.

YOUR SOLID CHUNKS OF VINYL, POLYETHYLENE OR OTHER PLASTICS REDUCED TO GRANULES, READY FOR THE EXTRUDER OR MILL IN ONE PASS.

ALSTEELE GRINDERS, made in a complete range of sizes up to 150 H.P., for every plastic granulating requirement, are represented by:

**Representatives**

**New York Area:**
RICHARD ROSS
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2025 Martha Lane
Santa Ana, Calif.

***Complete information is available from our representatives or by writing or phoning us at***

## 82A HERBERT STREET, FRAMINGHAM, MASS.

**Telephone: TRinity 5-5246**

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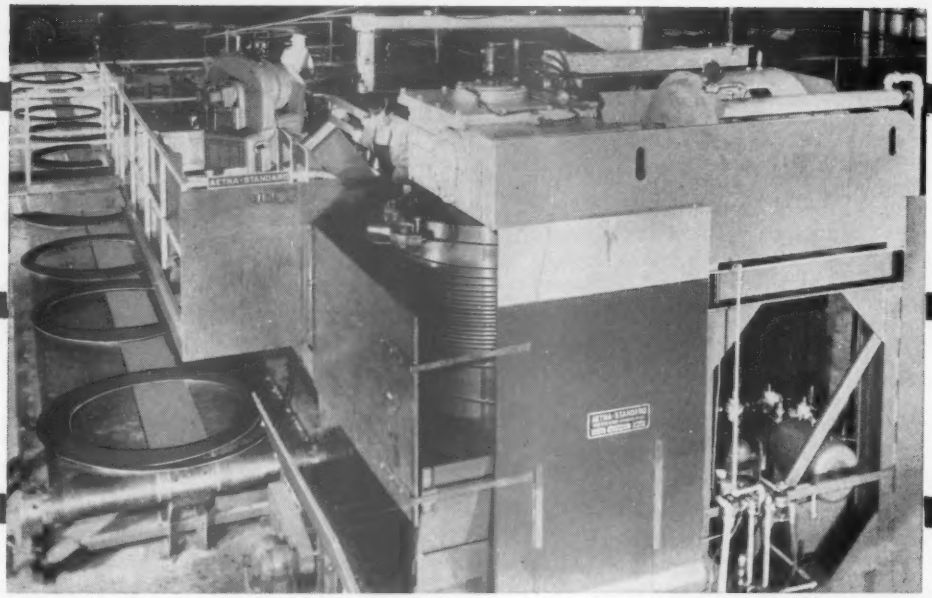
**Specialists in the grinding and pelletizing of PLASTICS for THE WIRE AND CABLE INDUSTRY**

# ECONOMICAL PRODUCTION

# OF THIN WALL, SMALL

# DIAMETER TUBING



One of many Bull Block installations made by Aetna-Standard. Aetna's Bull Blocks range in size from 12" in diameter to 60" in diameter at speeds up to 2,000 feet per minute. Types—Horizontal, Inverted or Vertical.

Coil handling is most important for economy in production with a Bull Block. Aetna's engineers have concentrated on the method of moving the tube from the drum after drawing and the method of transferring the material back to the block. The payoff tray, the ease of entry, and the ease of gripping, ungripping and loading add to the economy of operation.

Our hydraulic feed gives absolute accuracy in traversing the die to the drum during drawing. Unique electrical controls give the operator instant control of speeds from zero to 2,000 feet per minute.

There's nothing new about the use of Bull Blocks. They have been in use for many years. But the design remained unchanged until Aetna-Standard, a pioneer in Drawbenches and other cold draw equipment, completely redesigned the Bull Block and made it a practical unit for high-speed production of small diameter, thin wall tubing. We have made installations for most of the major producers of copper, brass and aluminum tubing.

# AETNA • STANDARD

**THE AETNA - STANDARD ENGINEERING COMPANY**

**GENERAL OFFICES: PITTSBURGH, PA. • PLANTS: ELLWOOD CITY, PA., WARREN, OHIO • RESEARCH LABORATORY: AKRON, OHIO**

CONTINUOUS GALVANIZING LINES • CONTINUOUS ANNEALING LINES • CONTINUOUS ELECTROLYTIC TINNING LINES • SIDE TRIMMING AND SHEAR LINES AND OTHER FINISHING EQUIPMENT • CONTINUOUS BUTT WELD PIPE MILLS • SEAMLESS TUBE MILLS • DRAWBENCHES AND OTHER COLD DRAW EQUIPMENT • ROLLS AND CASTINGS • EXTRUDERS, MILLS, PRESSES FOR RUBBER, PLASTIC AND CHEMICAL

# Are You Sure You Are Using the BEST Wire for Your Application?

• If your product involves the use of wire—PAGE asks—"*Can a new wire specification help make your product a better value?*" PAGE has helped many manufacturers to do so and—without increasing their manufacturing cost.

Here at PAGE we are in an ideal position to work with wire users in developing better wire for specific needs. PAGE is a specialty wire mill. Manufacturing wire has been our sole business since 1902.

Our engineering and production staffs regard wire as an important tool which can be designed and made to fill the exact requirements of our customers. Over the years PAGE has maintained a progressive attitude which has pioneered many "**firsts**" in the wire business. Among this list are items such as—

**The first adoption of the patenting process in the U.S.**
**" " to use Tungsten Carbide Dies**
**" " commercial producer of Aluminized Wire**
**" " to produce and promote Stainless Steel Strand**
**" " Woven Wire Fence**
**" " Stainless Steel Fence**
**" " All-Aluminum Fence**

Above all, PAGE is a dependable wire source. Many of our customers have grown with PAGE for nearly half a century. PAGE experience, talents and facilities are available to you at all times. We will be glad to work with your people in analyzing your wire needs, and if found advisable, in developing a new wire specification which may add to the usefulness and value of your own product.

## PAGE -a Dependable Source for GENERAL WIRE

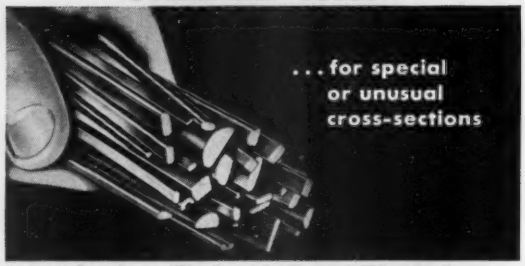
Partial list of PAGE General Wire materials, sections and special purpose wires:

| MATERIALS | SECTIONS |
|---|---|
| Low Carbon | Rounds |
| High Carbon | Half Rounds |
| Low Alloy | Ovals... Flats |
| Stainless Steel | Half Ovals |
| Armco Ingot Iron | Squares |
| Aluminized | Special Shapes |

### SPECIAL PURPOSE WIRES

Aircraft
Antenna
Armature Banding
Belt Hook
Broom
Buckle
Button Fastening
Clip
Core (ACSR)
Hairpin
Lashing
Lock Washer
Safety, Lock
Shaped
(see next column)
Signal Corps
Spiral Binding
Spring, Mechanical
Spring, Upholstery
Stapling
Stitching, Automotive
Strand
Telephone
Telegraph
Thermocouple
Tire Bead
Weaving
Welding
(see next column)
—and others

## PAGE -a Dependable Source for SHAPED WIRE




**Many Grades** • We furnish Shaped Wire in Low or High Carbon, Aluminized, Low Alloy or Stainless Steel, and in Armco Ingot Iron.

**Many Sizes** • Cross-section areas to and including .0625 sq. in. Flats and rectangles to 3/8" (width-thickness ratios to 6:1). Also rounds, half rounds, ovals, half ovals, squares, and specials.

**Packaged Right** • PAGE Shaped Wire—in standard or special coils or in random, exact or multiple lengths, is packaged as you want it: bare bundles, waterproof paper-wrapped, burlapped, boxes, cartons, Leverpaks—palletized on request.

***(SPECIAL NOTE** • We do not stock finished shapes We manufacture to customer specification)*

## PAGE -a Dependable Source for HELPFUL LITERATURE

**SHAPED WIRE • *Booklet DH1226***
Here is a 16-page booklet that is crammed full of useful information of value to every wire user. It tells you how to cut costs with PAGE Shaped Wire. It gives complete information on available grades of steel...tempers and finishes...size range, etc. It explains what information to include on inquiries and orders.

Also, **Booklet DH1226** contains page after page of useful standard tables, among which are:

- **Mensuration Factors • Carbon and Alloy Steel Weights**
- **How to Calculate Areas of Common Shapes**
- **Physical Properties of Steel Wire**
- **Decimal Equivalents • and many other useful tables**

You will find this booklet of great value.
Write our Monessen, Pa., office for **Booklet DH1226** today!

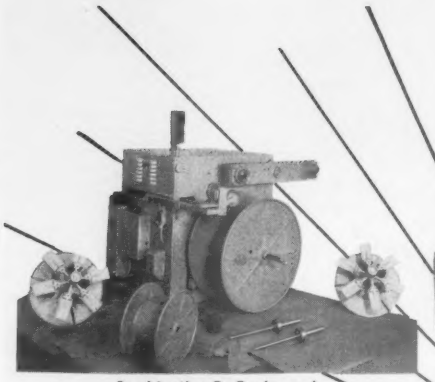
**"ACCO ALUMINIZED" WIRE**
***Folder DH537*** • You will want the complete facts on the amazing new "ACCO ALUMINIZED" wire—the wire that combines the strength of steel with the corrosion-resistance of aluminum. **Folder DH537** explains how this revolutionary new wire provides double protection...tells how its unusual physical properties make it superior for almost endless regular and special wire applications. "ACCO ALUMINIZED" wire is an exclusive PAGE product.

***Write our Monessen, Pa., office for Booklet DH537***

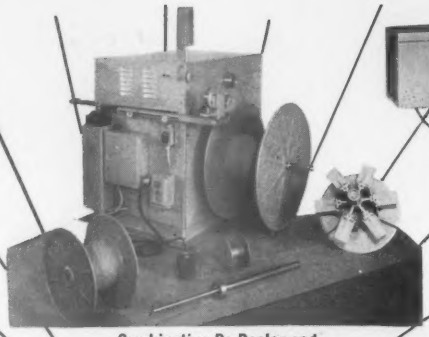
**Page Steel and Wire Division**
**AMERICAN CHAIN & CABLE**

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

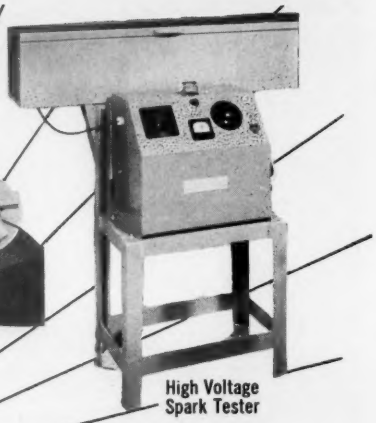
ACCO



Combination Re-Reeler and
Re-Spooler with Indexing Head

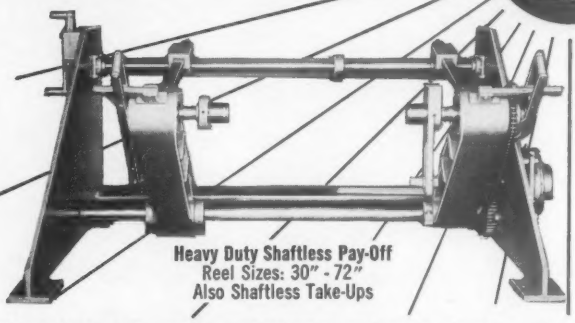


Combination Re-Reeler and
Re-Spooler with Interchangeable
Shaft Features

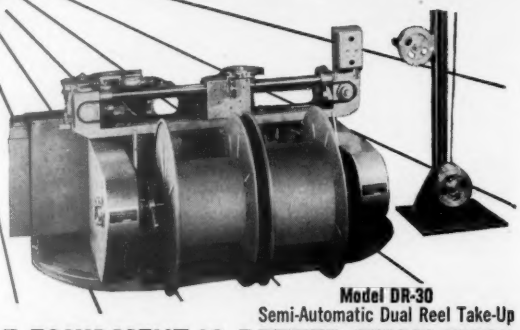


High Voltage
Spark Tester

# FOR ACCURACY — DAVIS WIRE & CABLE EQUIPMENT — FOR DEPENDABILITY



Heavy Duty Shaftless Pay-Off
Reel Sizes: 30" - 72"
Also Shaftless Take-Ups



Model DR-30
Semi-Automatic Dual Reel Take-Up

## THE NEWLY REDESIGNED *DAVIS WIRE & CABLE EQUIPMENT* IS BETTER THAN EVER

Modernized, streamlined and engineered for fast production of safely insulated wire and cable, the newly redesigned DAVIS ELECTRIC line of Spark Testers, Pay-Offs, Take-Ups, Counters, Spoolers, Traverses and Capstans is now offered as the finest ever conceived and produced by DAVIS ELECTRIC engineers. Before you buy, you owe it to your pocketbook as well as your business reputation to learn what this unexcelled machinery can do to better satisfy your customers (and your stockholders!). Refinements and advancement in designs qualify the 1958 DAVIS ELECTRIC line to surpass in performance previous DAVIS products in use in 80% of the industry's wire mills and some of which have been in operation for 15 years without maintenance problems!

What better tribute to quality can one ask?

Write for complete details and find out how DAVIS ELECTRIC can improve your wire and cable production and promote profit in your plant.

DAVIS WIRE & CABLE EQUIPMENT

**DAVIS ELECTRIC CO.**

WALLINGFORD, CONNECTICUT

DUAL and SINGLE TAKE-UPS • PAY-OFFS • CAPSTANS
SPARK TESTERS • RE-SPOOLERS
RAM-TYPE TEFLON EXTRUDERS

*Map showing the location of the Morgårdshammar Works*

More than a hundred years ago, in 1856, Morgardshammar was founded in the heart of Sweden's industrial district. For the past sixty years we have been designing and building wire drawing equipment to meet the ever increasing needs for higher, trouble-free production. Our accumulated design and building experience is your guarantee of the best possible equipment to meet your own specific requirements.

Our competent U.S. staff is available to discuss engineering, production and equipment problems related to your present or anticipated wire drawing programs. Please contact us for service or information.

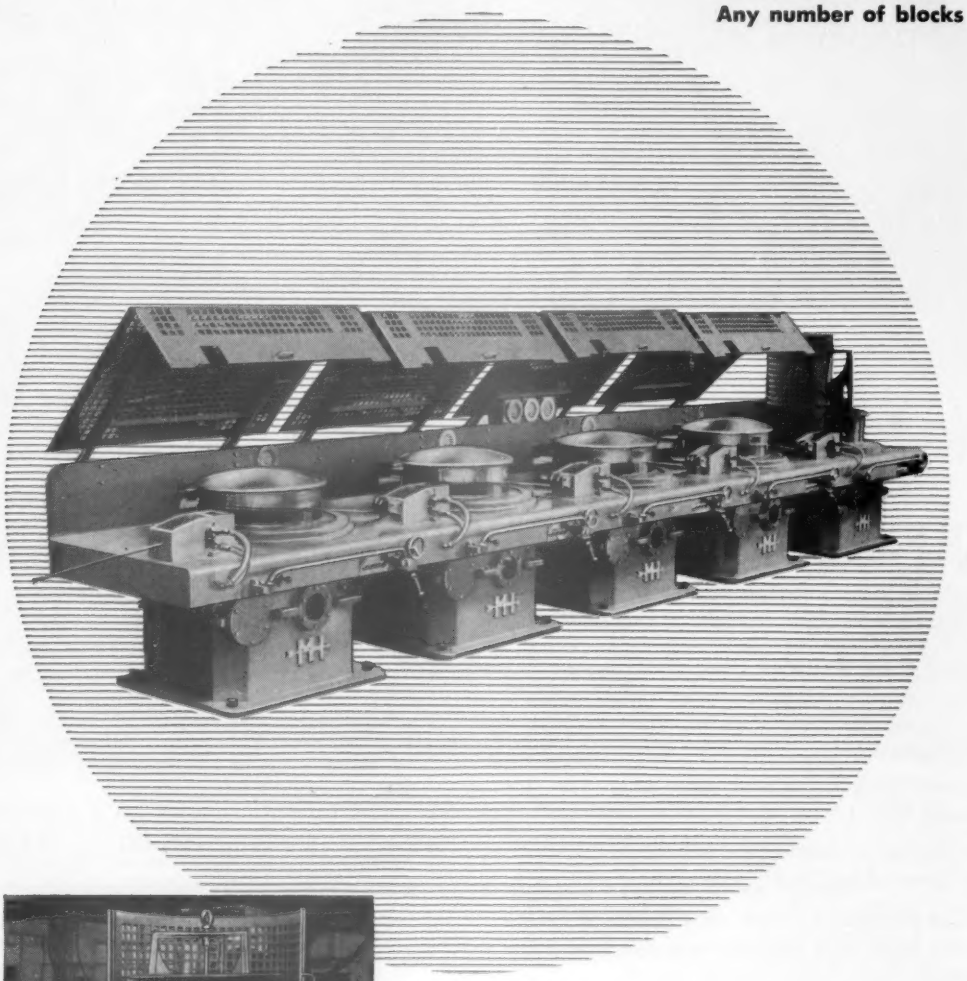
# MORGÅRDSHAMMAR

**Morgardshammars Mek. Verkstads AB, Morgardshammar, Sweden**
**CABLE: Morgardshammar, Ludvika. Telephone, 0240-71100**

***U.S. OFFICE*** **M. H. MACHINES**
**19002 LOMOND BLVD.**
**CLEVELAND 22, OHIO**
**TELEPHONE: WYoming 1-5830**

# THE BEELINE

**Three standard sizes**
**All types of materials**
**Any number of blocks**



**PRECISION WITH RUGGEDNESS**

MH

# USE FILTERED MINERAL OIL INSTEAD OF SOLUBLE OIL

Wire drawing firms are saving as much as $12,000 a year by replacing soluble oil in the lubrication of dies with continuously filtered mineral oil. They thus eliminate build up of fats in the equipment, clogging of jets, and interrupted production necessitated for cleaning purposes.

By shifting to mineral oil and filtering it they now enjoy these advantages:

1. The oil remains in the same condition as new. It does not have to be changed—not just for months, but for years.

2. Die life is increased 50% or more.

3. Higher drawing speeds can be employed.

4. It is possible, in many cases to substitute Carbide Dies in place of diamond dies.

5. Clogged oil passages causing burned dies are eliminated.

The procedure is simple. A mineral oil of low viscosity, containing E. P. additive and having high heat conductivity is used. This oil is then passed through a Hercules Pressure Leaf Filter to remove suspended solids. Since diamond and metal dust is removed from the oil continuously the oil can be used indefinitely.

We have several score of our Pressure Leaf Filters in use by wire drawing concerns for the filtration of mineral oils. In most installations these machines have paid for themselves in a few months through lowered oil and die costs and increased production (For example one concern is now drawing 21,000 pounds of wire before changing a die as compared with 6,000 pounds when it was using soluble oil.)

Why continue to suffer short die life, reduced drawing speeds, lowered production and high oil costs when you can eliminate these disadvantages through the use of Hercules Filters and mineral oil?

For full details of this method of using mineral oil and a Hercules Pressure Leaf Filter in your wire drawing operation write for Paper delivered before the Wire Association in New York City, which gives complete data on the economy and effects of using filtered mineral oil for the lubrication of wire drawing machines.

## HERCULES FILTER
**CORPORATION**

**191 Ethyl Avenue**
**Hawthorne, New Jersey**

# LARIBEE WIRE & EQUIPMENT CORP.

## CAMDEN, NEW YORK

### FABRICATORS OF BARE & TINNED COPPER WIRE

- ***SOLIDS***
- ***BUNCHED WIRE***
- ***STRANDED WIRE***
- ***FLEXIBLE CABLES***
- ***BRAID***
- ***SHIELDING WIRE***

PHONE: CAMDEN 42 FOR YOUR REQUIREMENTS
WE WANT TO SERVE YOU.

If you are considering fabricating your own wire, our affiliate will be pleased to send you specifications and quotations on any of the following:

***ROD, INTERMEDIATE AND FINE WIRE DRAWING MACHINES***
***BUNCHERS AND CONCENTRIC STRANDERS***
***TINNING AND ENAMELING EQUIPMENT***
***CABLING MACHINES***
***ANNEALERS***

**FOR INFORMATION PLEASE WRITE**

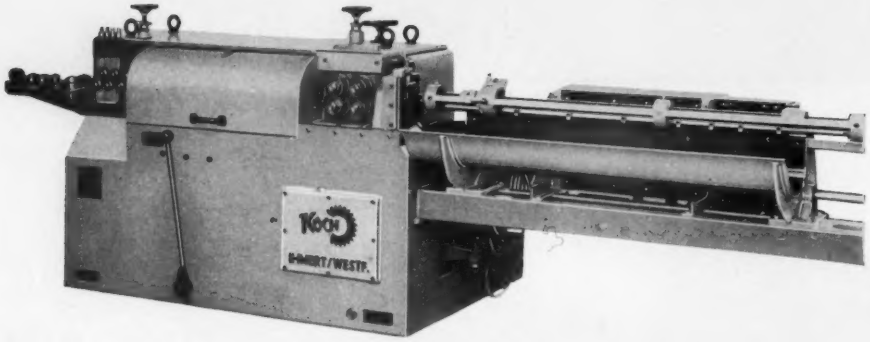
## LARIBEE MACHINE CO., INC.

### CAMDEN, NEW YORK

BUILDERS OF WIRE MANUFACTURING EQUIPMENT

# AUTOMATIC WIRE STRAIGHTENING AND CUTTING-OFF MACHINE

**WITH INFINITELY VARIABLE SPEED ROTARY STRAIGHTENER ARBOR**



KOCH

ERNST KOCH & CO · KG MASCHINENFABRIK · IHMERT i. WESTFALEN

*EXCLUSIVE REPRESENTATIVE*

## PAUL REICHER MACHINERY

**P. O. BOX 127 WILLOWDALE, ONTARIO, CANADA**

# 500 Feet Per Minute!

## With a Lewis Wire Straightening and Cutting Machine

No. 4FH "Travel-Cut", Automatic Flying-Shear Wire Straightening and Cutting Machine designed for high-speed cutting. Capacity in mild steel, 1/16" to 1/4" . . . high tensile, alloy and stainless 7/16" maximum.

★ The Lewis No. 4FH is typical of the new developments Lewis engineers have perfected to meet tomorrow's production schedules today. For example, the amazing No. 4FH, designed for straightening and cutting short lengths, can produce 18,000, 12"–18" lengths of 1/4" welding rod per hour.

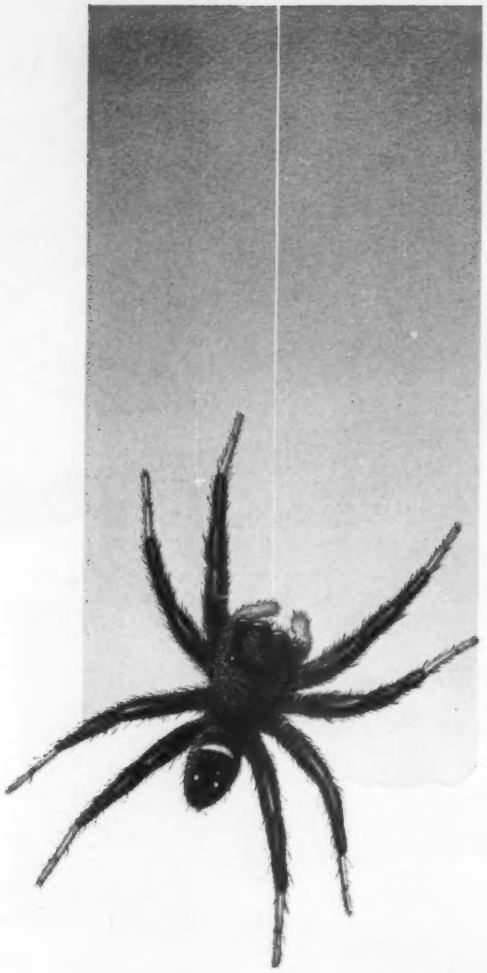
Now, Lewis announces a further development, the new No. 4FHA, designed for straightening and cutting any length at speeds up to 500 FPM. The No. 4FHA is a high-speed Travel-Cut Flying-Shear model equipped with Air Clutch and Air Brake.

A compound sliding gear transmission has six flywheel speeds and 20 feed speeds through the range of 75 to 520 FPM, permitting the selection of the correct speed for various diameters and materials.

There are 46 models in the Lewis line designed to handle wire from .012" to 1" in diameter. Write us . . . we have a machine to meet any wire straightening and cutting requirement.

**SEE THE NO. 4FHA IN OPERATION AT BOOTH 1527, NATIONAL METAL EXPOSITION, CLEVELAND, OHIO, OCTOBER 27-31.**

**THE LEWIS MACHINE COMPANY** 3441 East 76th Street • Cleveland 27, Ohio
A Division of Curtis Mfg. Co.

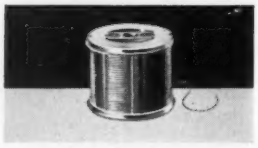


# Built-in spooling control...

Precise control, built in by nature, lets the spider spool out its fine silken thread without a break. Sylvania wire is precision-wound to give you built-in spooling control too. Smooth, uniform spool-out holds breakage to a minimum. Machine downtime is reduced and production rates are increased. You get a better end-product at lower cost with Sylvania precision-wound wire.

Precision spooling is just one of the advantages you gain when you specify Sylvania wire. You get uniform high quality and a wider selection of sizes and types. As the only major wire supplier with complete facilities for plating and cladding, Sylvania can also provide you with an experienced, objective recommendation as to whether a plated or clad wire is best suited for your application.

For premium wire that can be processed to fit almost any use and spooled to meet exacting requirements, check with Sylvania.

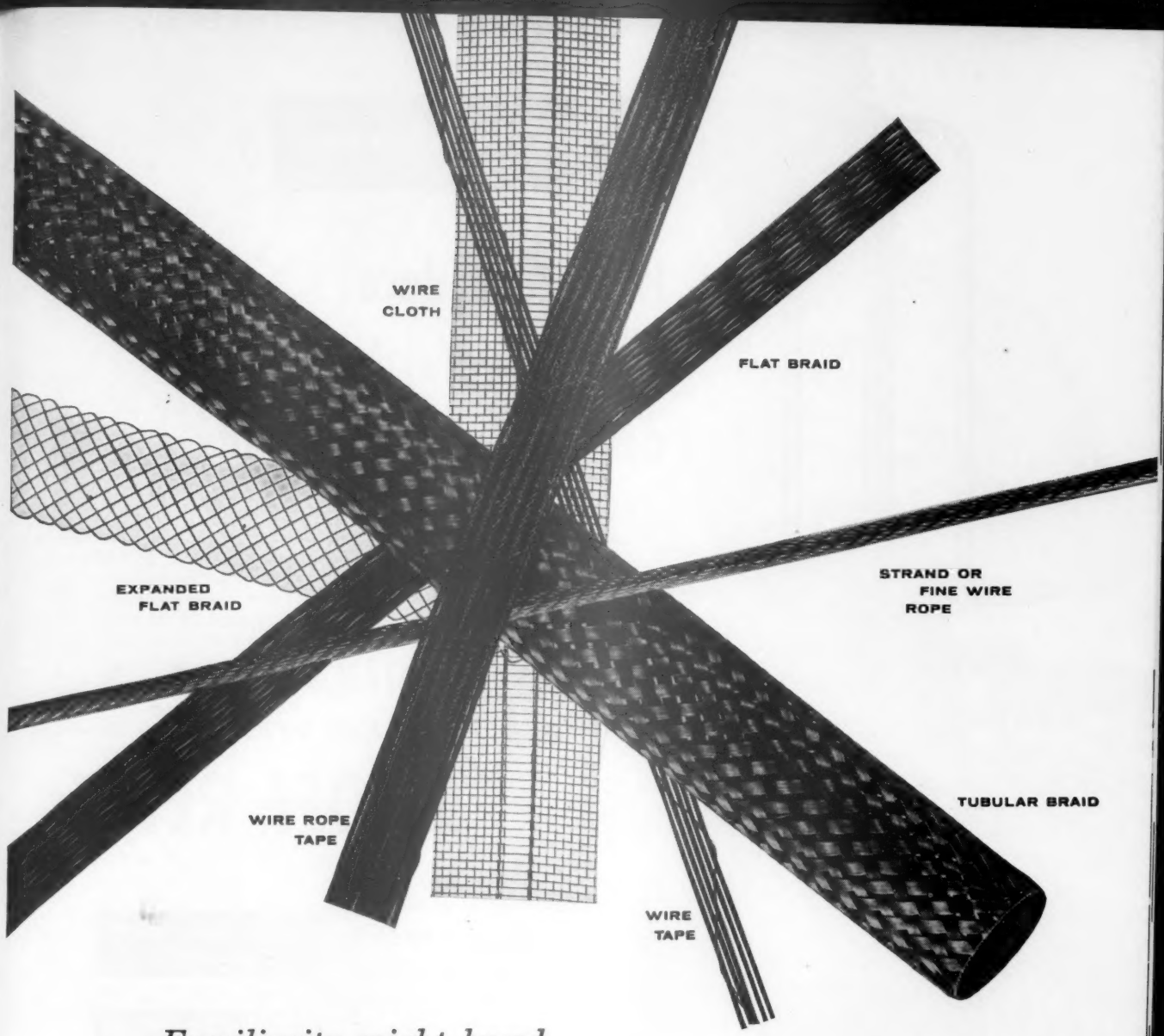


**Sylvania Wire for Processing**
Stainless steel, nickel alloys, and plated and clad wire in just about any combinations are available from Sylvania. For information write to: Sylvania Electric Products Inc. Parts Division, Warren, Pa.

**SYLVANIA** PARTS DIVISION

Custom Molded Plastics
Custom Metal Stampings
Custom Welded Parts
Alloy, Clad, Plated Wire
Plate Metal Strip
Electronic Components
Fluorescent Components

LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY




*Familiarity might breed*

# NEW PRODUCT IDEAS!

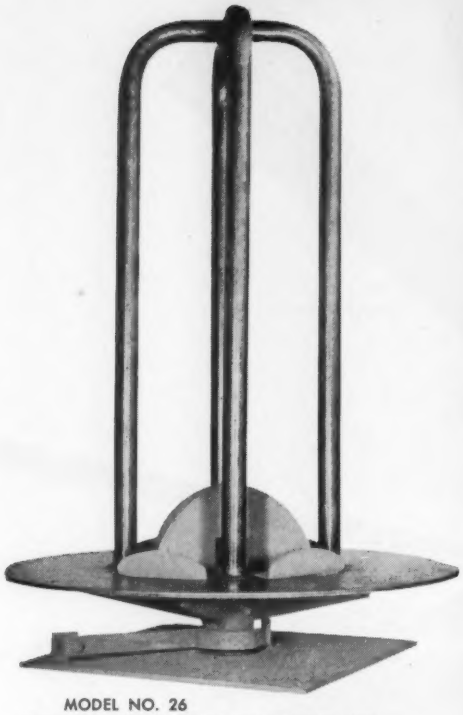
The wire fabrications shown here, highly developed specialties of National-Standard, are available in many types and sizes. Each can be produced in any metal that can be drawn into wire.

These materials are used in numerous products today for many different reasons... for strengthening, stiffening, protection, safety, decoration, filtering, screening, heat or electrical conductivity, grounding, etc., etc.

Can one of these materials meet a present or new product requirement of yours? You'll never find an organization more cooperative or better qualified to help you fully explore any such ideas. Just get in touch with National-Standard, Niles, Michigan.

**NATIONAL STANDARD**

**DIVISIONS: NATIONAL-STANDARD, Niles, Mich.;** *tire wire, stainless, music spring and plated wires, flat and tubular braid and wire cord*
**WORCESTER WIRE WORKS, Worcester, Mass.;** *music spring, stainless and plated wires, high and low carbon specialties* • **REYNOLDS WIRE, Dixon, Ill.;** *industrial wire cloth*
**WAGNER LITHO MACHINERY, Secaucus, N. J.;** *metal decorating equipment* • **ATHENIA STEEL, Clifton, N. J.;** *flat, high carbon spring steels*



MODEL NO. 26
WIRE CARRIER MOUNTED ON PAY-OFF REEL

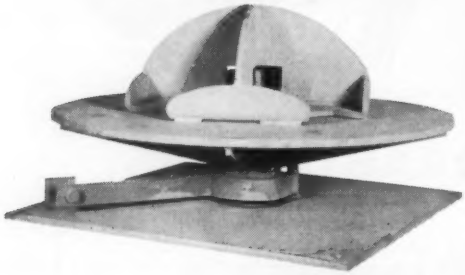
WORKING WONDERS WITH WIRE:

# How to reduce changeovers, handling, down-time, scrap-ends 4 to 10 times!

**Leading wire producers and fabricators across the country use (and recommend)**

## NORTHERN INDIANA STEEL'S HIGH CAPACITY, HEAVY DUTY

# WIRE CARRIERS and PAY-OFF REELS



MODEL NO. 26
PAY-OFF REEL

Let us know exactly what your operating needs are. If we don't already have the wire carriers and pay-off reels in stock, we're ready to make up your order as per your exact specification. In any case, we'll be pleased to quote you promptly in the quantities you specify.

**They feed more smoothly**

**Handle 2000# to 4000# coils**

**Stack and store easily**

**And—They're Designed and Produced To *Your* Specifications**

## Northern Indiana Steel Supply Co., Inc.

Fabricating Division, Michigan City, Indiana
TELEPHONE TRiangle 4-3241

# New Life for old wire furnaces

Rebuilding outmoded furnaces—adding high input "O" tubes and high velocity circulation systems—increases the average wire annealing production by at least 40 percent, with no increase in floor space requirements.

Lee Wilson engineers have developed a wire furnace modernization program that will bring your old furnaces up to date quickly at a minimum of expense.

Why not look into the Lee Wilson plan. The details are available by contacting the Lee Wilson representative in your area or writing direct.

**Lee Wilson*** **ENGINEERING COMPANY, INC.**

20005 WEST LAKE ROAD • CLEVELAND 16, OHIO

HIGH CONVECTION ANNEALING FURNACES
***MAKE THE BEST METALS BETTER***

*ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNACES

9975

# ANNOUNCING

## BRAND NEW WEMCO

# COIL-TO-REEL REWINDER

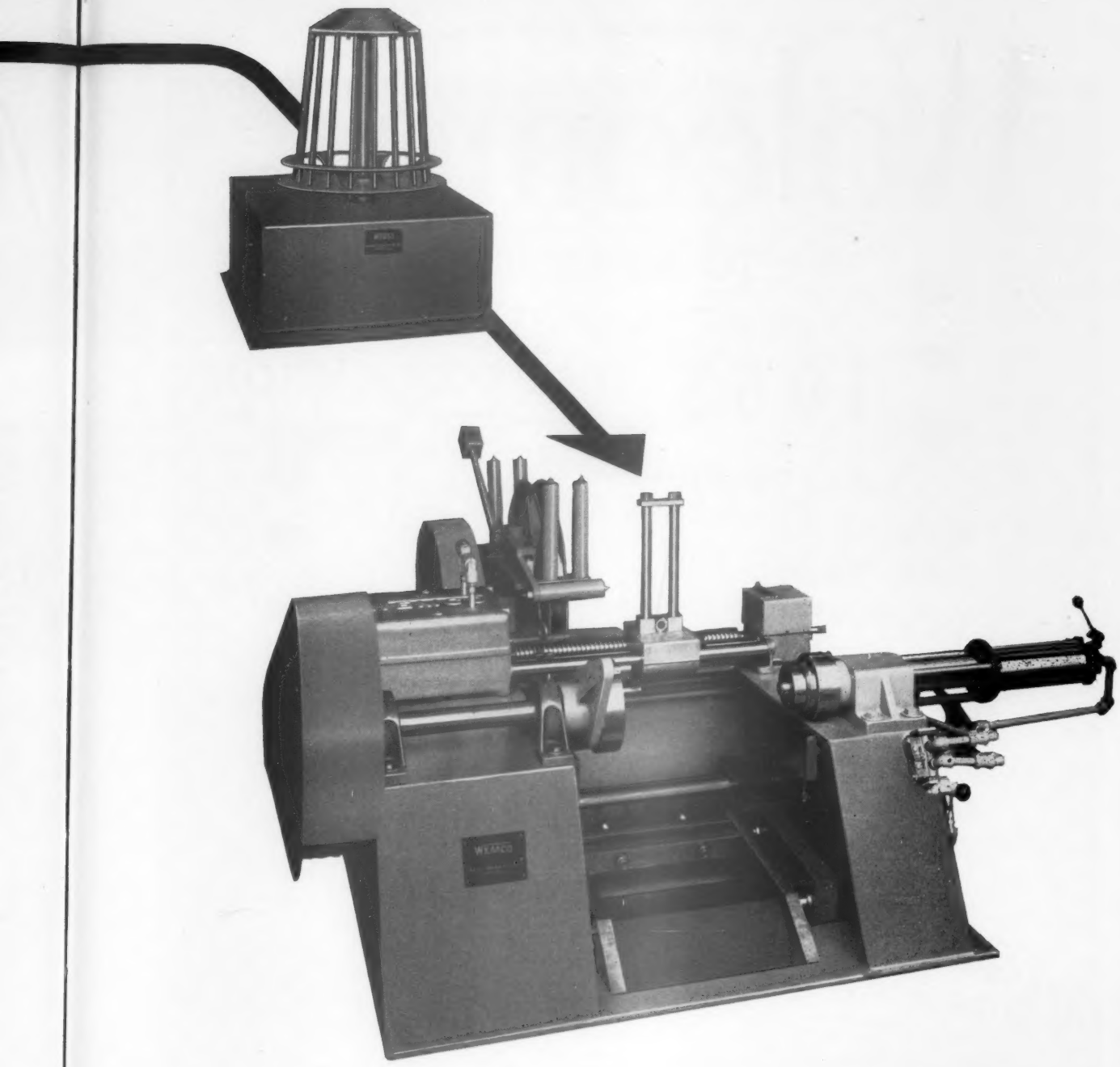
FAST, ACCURATE SPOOLING OF

- ROPE WIRE
- ACSR CORE WIRE
- ARMOR WIRE

FROM COILS TO STRANDER BOBBINS

- PRECISION LAYERING
- CONSTANT LINEAL SPEEDS
- PNEUMATIC REEL HANDLING
- PREDETERMINED FOOTAGE

***WRITE FOR COMPLETE INFORMATION*** →




**WIRE EQUIPMENT MANUFACTURING COMPANY, INC.**
**1168 SOUTH OLDEN AVENUE, TRENTON 10, N. J.**
**EXport 6-9908**

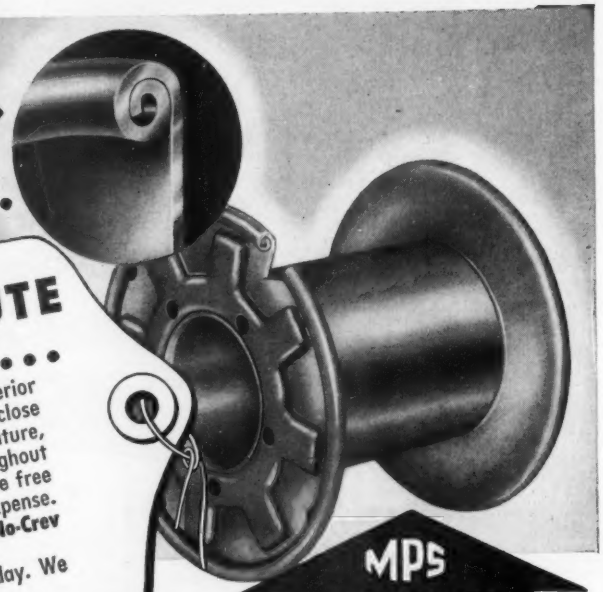
WEMCO

# Welcome

## TO MEMBERS AND GUESTS ATTENDING THE 1958 WIRE CONVENTION

YOU TOO SHOULD USE
SUPERIOR MPS SPOOLS AND REELS
WITH THE EXCLUSIVE HEAVY DUTY
CONVOLUTE DURA CURL RIMS

The Difference
IS HERE.....



NEW MPS CONVOLUTE DURA CURL RIMS...

The difference between just any spool or reel and Superior MPS CONVOLUTE DURA CURL Rims is well worth your close attention. Because now, with this exclusive MPS feature, maximum strength and rigidity are obtained throughout the reel heads. You can now have continuous trouble free high speed winding, without spool straightening expense. These new MPS spools also have the famous **No-Crev** feature.
Ask about MPS CONVOLUTE DURA CURL RIMS today. We invite your inquiries.

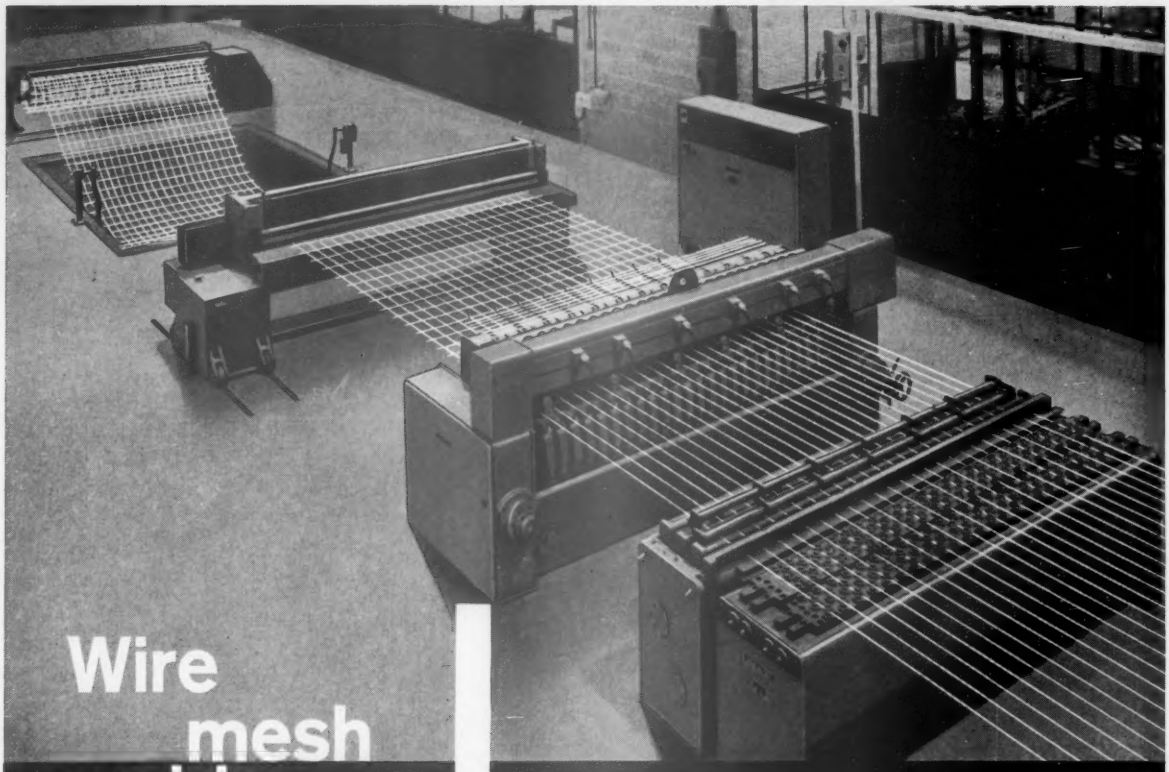
MPS
CONVOLUTE
Dura Curl
Spools & Reels
give you brute strength with dimensional precision, concentricity, and balance. Another patented MPS development engineered to **help you!**

18 West St., Attleboro,
Massachusetts, U.S.A.
Telephone Attleboro 1-0848

Mossberg PRESSED STEEL Corporation
Division of Wanskuck Co.

#110

"A recent North American Installation"



# Wire mesh welder

for the manufacture of welded fabric sheets and rolls

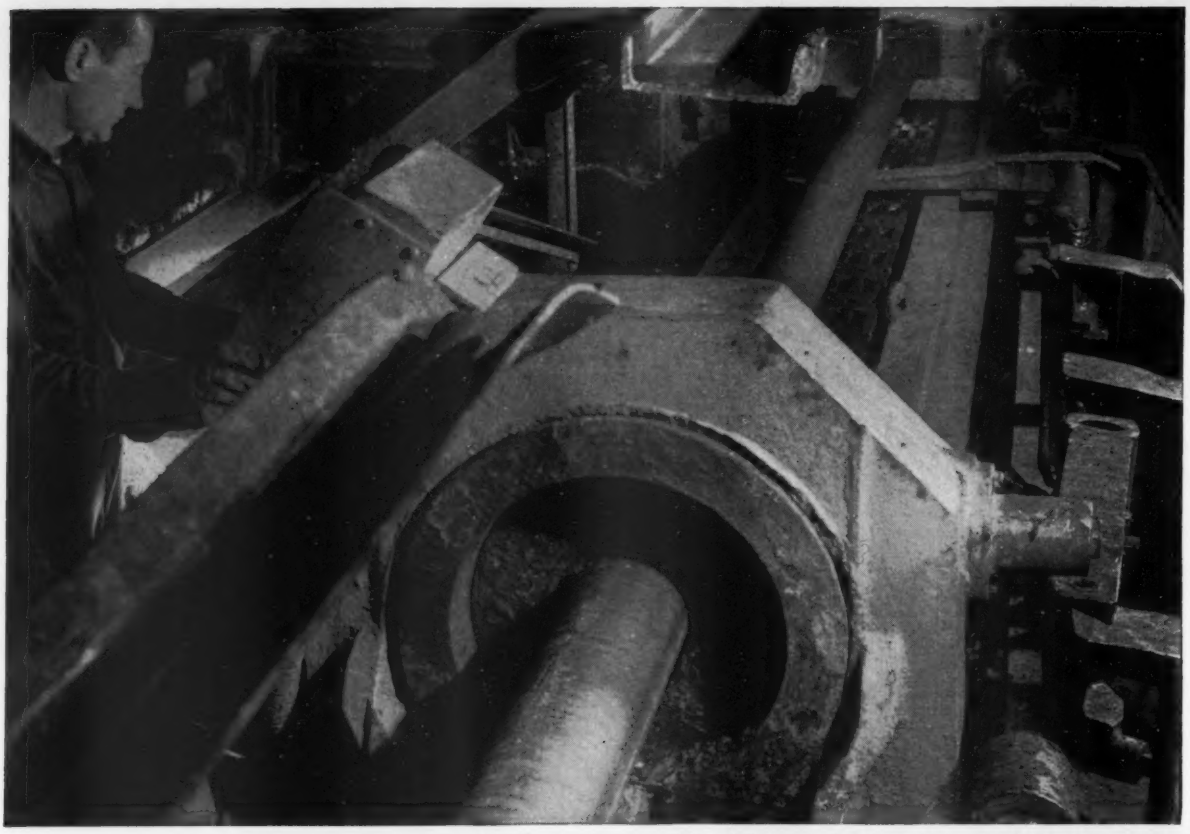
**Advantages of the welder**

Quick change from one mesh size to another.
Infinitely variable cross and longitudinal wire pitch for any mesh dimension.
Minimum wear of the large-surface electrodes by suitable electrode shape and material, as well as efficient air cooling.
Maximum power factor of the transformers as a result of minimum inductive losses.
Three-phase connection to the mains supply. Electronic current switching by IGNITRON high-power tubes avoiding current surges.
No tearing of the welded mesh and no electrode burning when feeding bent cross wires since the welder stops automatically in such a case.
Effective cushioning of the carriage impact.
Minimum maintenance and servicing thanks to permanent lubrication of all gliding and rotating parts. Automatic oil fog lubrication of all air presses.
Automatic and interlocked sequence of operations and, therefore, always minimum duration of the total welding cycle.
Electrode pressure at every welding spot and feed power are infinitely variable.
Available with attachment for welding three different and preselectable cross wire pitches.

**SCHLATTER**

Representative for Canada and USA
P. REICHER - Machinery and Equipment
P. O. Box 127, Willowdale, Ontario, Can.

H. A. SCHLATTER LTD. ZOLLIKON/ZURICH
Manufacturers of electric welding machines (Switzerland)



Rough casing (foreground) hits Carboloy die shoulder at 20 fpm. But before the casing has gone more than 2 feet, it is traveling 50-60 fpm . . . a speed not possible with steel dies.

In Pittsburgh Steel Company's Allenport Works . . .

# CARBOLOY® CARBIDE DIES REPLACED STEEL DIES . . . AND DIE COSTS FOR DRAWING 7″ CASING DROPPED 80%

To reduce costs, Pittsburgh Steel installed Carboloy dies to draw 7″ oil well casing. The result: die costs have been cut 80%, product quality improved, and production increased.

Each Carboloy die produces an average of 400,000 feet of 7″ casing. Steel dies on the same operation averaged only 3,200 feet. In dollars and cents this adds up to 320 feet of casing delivered for each dollar spent on Carboloy carbide dies against only 64 feet from a steel die dollar.

Product quality has been improved, too, because the extreme hardness and smoothness of the carbide surface prevents scoring . . . gives a better as-drawn finish. As a result, rejects have been reduced. And because there have been no failures in service with Carboloy dies, rejected casing due to die failure have been eliminated.

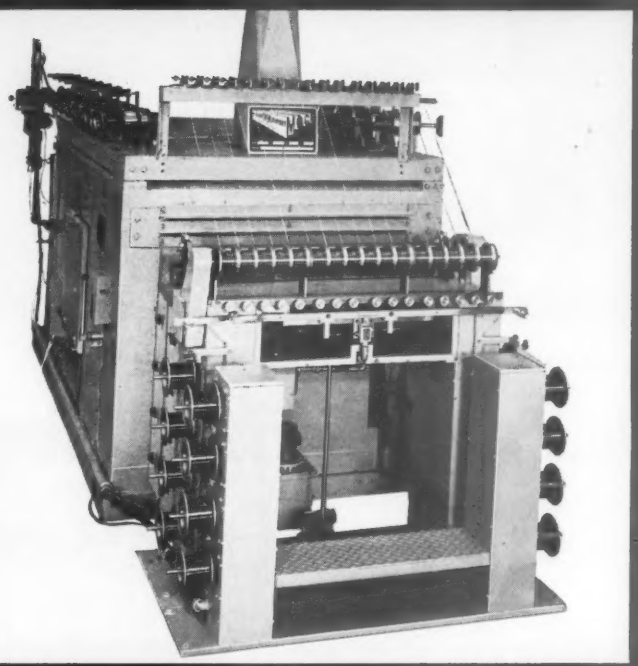
Whether you are flattening, drawing, extruding, or heading, a Carboloy cemented carbide die product can mean savings for you. For more information, in-plant technical assistance, or a copy of the new Carboloy Die Engineering Manual, write: *Metallurgical Products Department of General Electric Company, 11171 E. 8 Mile Ave., Detroit 32, Mich.*

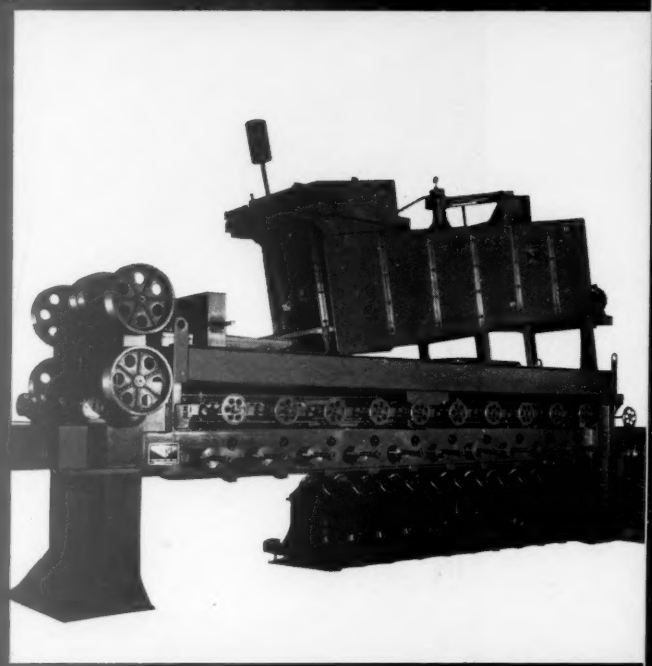
CARBOLOY®
CEMENTED CARBIDES

GENERAL ELECTRIC

# EXPERIENCE:

## Twelve years of development in gas-fired equipment — Three years of "on-the-job" production results





### WIRE ENAMELING MACHINES

Typical of the complete line is this type "B" machine which handles wire from 31 A.W.G. to 42 A.W.G.

Five other models complete the range from the finest through large rectangles. The horizontal, high volumetric, recirculating double-pass oven allows greatly increased production by rapid heat impartation and a high degree of temperature uniformity throughout the wire chamber. Other features include: a catalyst within the recirculating stream consumes solvents and releases heat energy, individual clutches in each head of the wire capstan, automatic braking device controlling wire tension.

### CONTINUOUS BRIGHT ANNEALERS

This is the first direct gas-fired annealer using the heating equipment as an internal inert atmosphere generator. Advanced mixing and burning equipments are utilized which exclude the need for external sources of steam or costly inert atmospheres. They are available in horizontal or vertical mounting positions. MOCO Annealers are of the high volumetric recirculating type with automatic air-fuel gas ration maintained over the entire range. They have a water sealed exit. No external source of inert atmosphere is needed.

WIRE ENAMELING DIVISION

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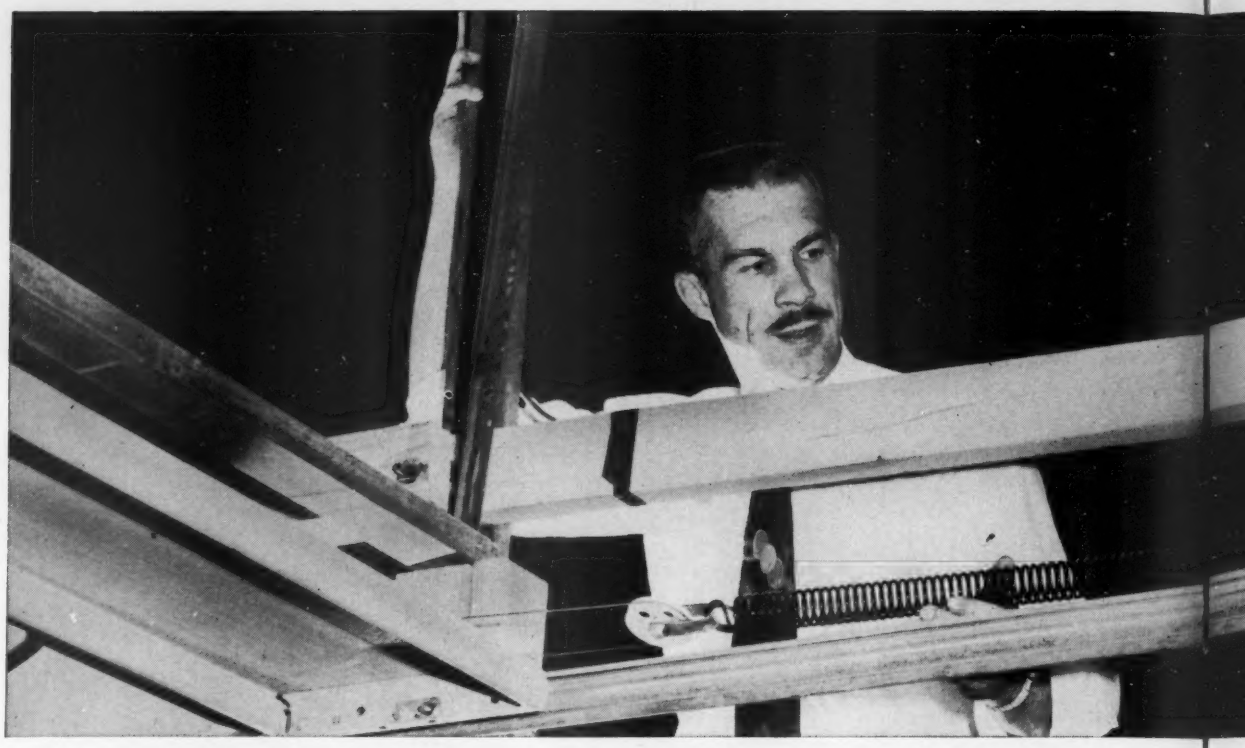
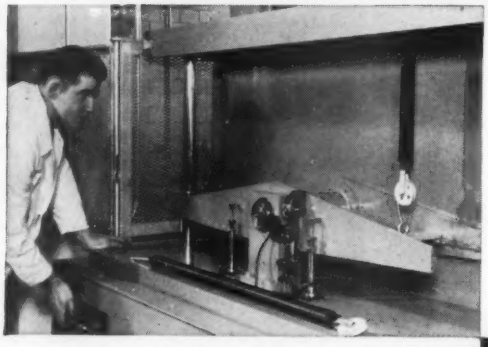
## MICHIGAN OVEN COMPANY

425 Brainard • Detroit 1, Michigan



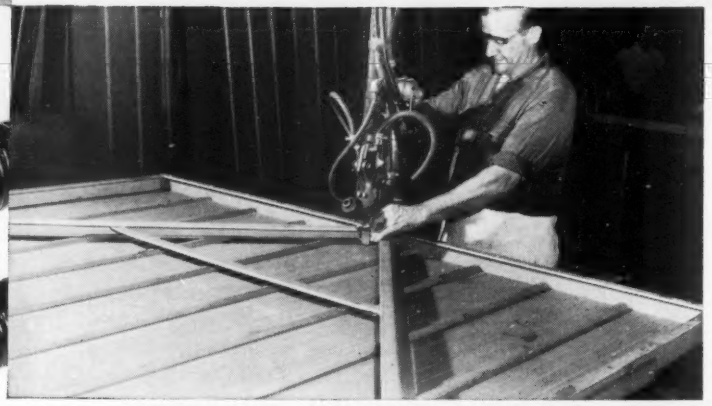


At Steel Door . . .

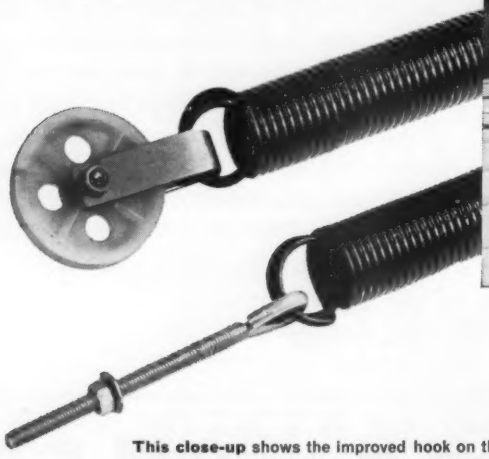
## USS American Springs

## thanks to AS&W

**In the American Steel & Wire Fatigue Laboratory,** a technician runs tests on a USS American Spring, designed for Steel Door use. On the basis of this test a change in hook design was recommended to give longer spring life.



**A Steel Door** workman assembles a Berry One-Piece Door. This company uses steel exclusively for all doors because of its many consumer advantages. Steel is stable, won't warp or swell. Steel doors need less maintenance and preparation, and steel doors are easy to operate.



**This close-up** shows the improved hook on the extension springs supplied by American Steel & Wire for the Steel Door overhead garage doors.

# stretched 31,000 times and still going strong...

## Spring Engineering Research Service

**The Steel Door Corporation,** Birmingham, Michigan, is the world's largest manufacturer of residential garage doors. For the production of these doors they use about 150,000 USS American Springs every year. Steel Door asked American Steel & Wire for a statistical evaluation of the fatigue life of the extension hook-type springs they use. The AS&W Spring Engineering Research Service tested these springs in the Fatigue Laboratory and recommended a change in hook design.

So successful was this design change that the life of the springs has been materially increased. At the Steel Door plant a cycle test was set up using USS American Springs on an overhead door. At the present time these springs have completed over 31,000 cycles without showing any sign of failure. This is the equivalent of 25 years of normal usage.

Mr. Ralph Qualman, Advertising Director and Service Manager, says: "It is extremely important that the springs—especially those used on sectional doors where the strain is greatest—have proper tension and a long life. American Steel & Wire supplies Steel Door with springs that meet their engineering specification and life expectancy."

**If you have a spring problem** or would like advice on the use of springs in your product, get in touch with our general offices in Cleveland, or any American Steel & Wire Sales Office. You can benefit from the knowledge of AS&W's Spring Engineering Research Service. The Service has been engaged in laboratory experiments of static and dynamic testing for 20 years and has accumulated invaluable data on stress and fatigue life of steel springs, while endeavoring to improve efficiency in the use of steel—from steel chemistry through product application—to more economically cope with today's rigorous demands. This accumulated knowledge of the AS&W Spring Engineering Research Service is at your disposal. *American Steel & Wire, General Offices: Rockefeller Building, Cleveland 13, Ohio.*

*USS and American are trademarks*

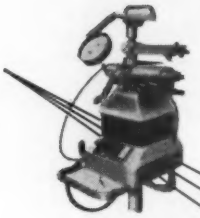
**American Steel & Wire Division of** USS **United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors • United States Steel Export Company, Distributors Abroad

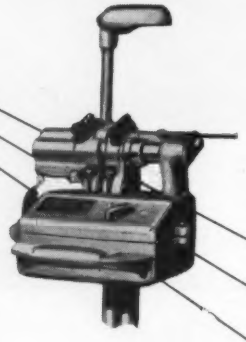
# SCHLATTER

**BUTT WELDERS are universally used throughout the wire industry.**

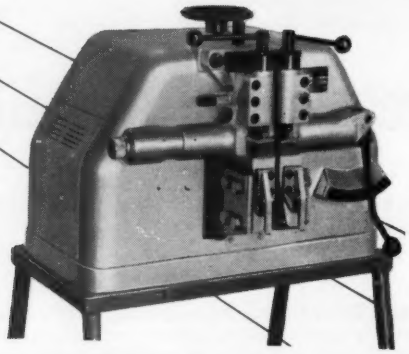
**SCHLATTER welders are available with special control equipment to weld high carbon steel.**



**MODEL "S", for**
**Steel: .01" - .08" diam.**
**Copper: .01" - .072" diam.**



**MODEL "E", for**
**Steel: .04" - .32" diam.**
**Copper: .04" - .25" diam.**



**MODEL "M", for**
**Steel: .16" - .51" diam.**
**Copper: .16" - .37" diam.**

***Our range includes:***

**Butt**
**Spot and**
**Seam Welders**
**Spot and Butt Welding Automatics**
**Special Purpose Welders**
**Modern Electronic Controls**

***You are cordially invited to submit inquiries on your welding problems or for equipment.***

## H. A. SCHLATTER, Ltd., Zollikon - Zurich

***Manufacturers of Electric Welding Equipment and Electronic Controls***

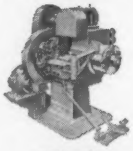
**Representative for Canada and the U.S.A.:**

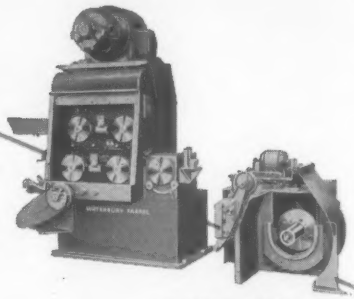
**Paul Reicher Machinery and Equipment**
**P.O. Box 127**
**Willowdale, Ontario, Canada**

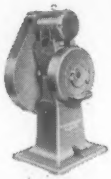
*Over 60 Years Of Broad Experience As A . . .*

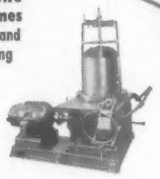
# SOURCE OF SUCCESSFUL WIRE MILL EQUIPMENT

WATERBURY FARREL
FOUNDED 1851


Stzing-Up Machines with Roll Pointers and Hand Swagers

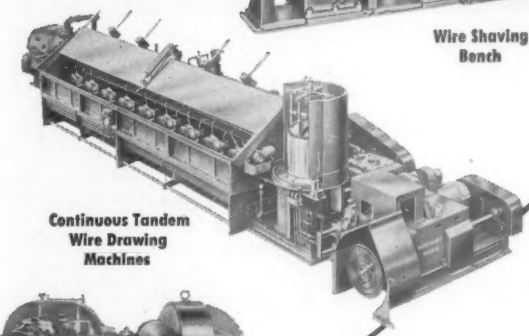

Upright Cone Wire Drawing Machines For Intermediate and Fine Wire Drawing

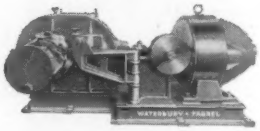

Rotary Swagers


Vertical Bull Blocks

Horizontal Swagers

Wire Shaving Bench


Continuous Tandem Wire Drawing Machines


Horizontal Bull Blocks

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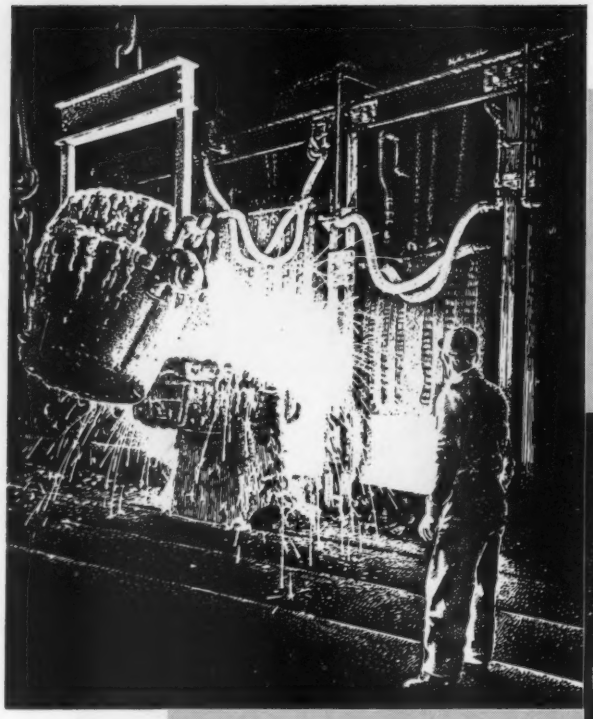

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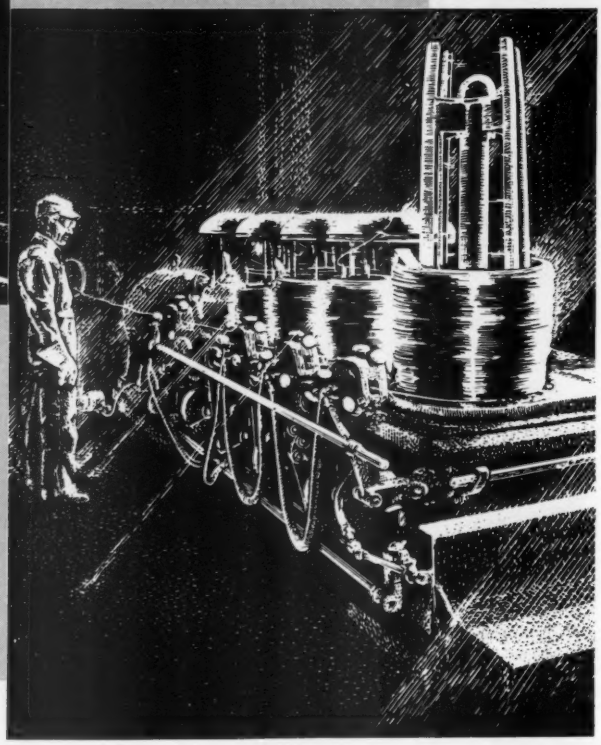

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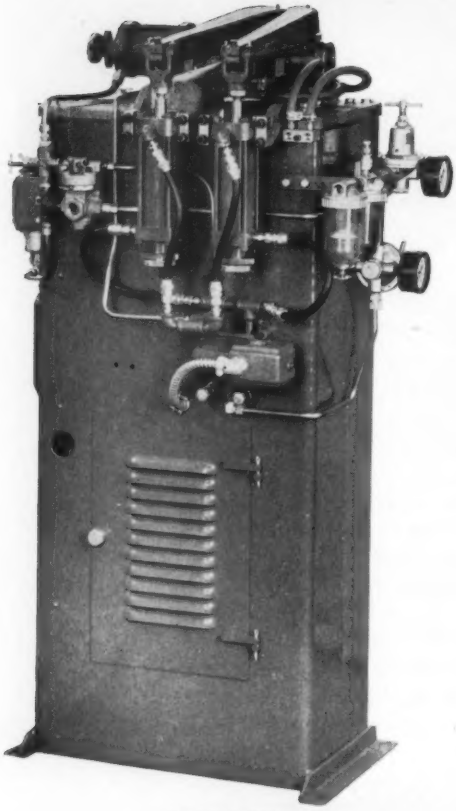

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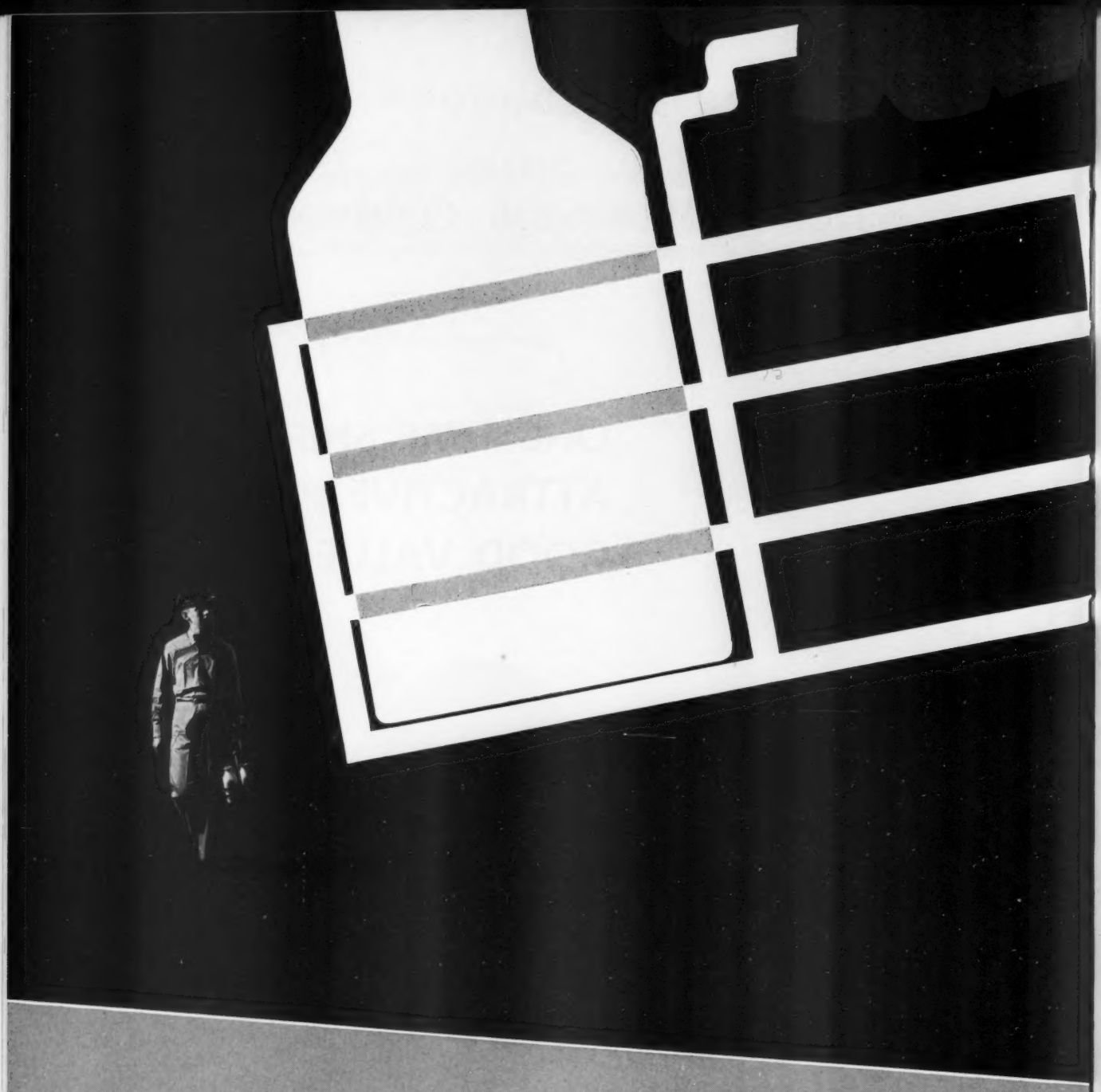

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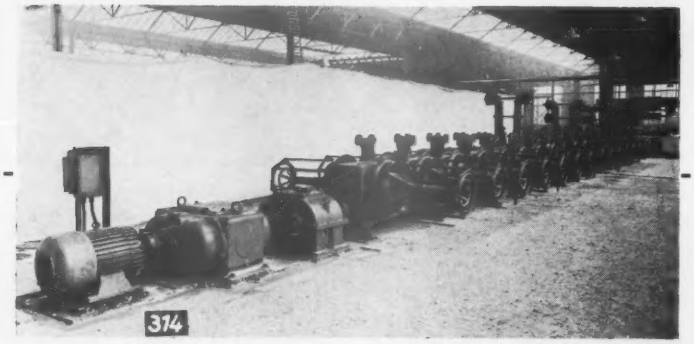
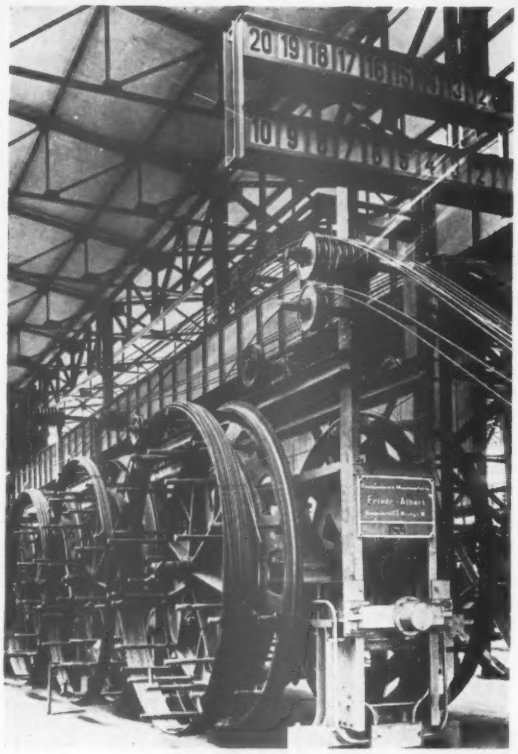
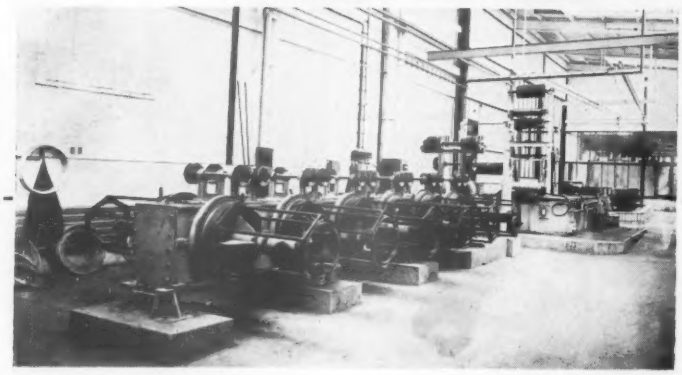



## TAKE-UP FRAMES




Take-Up Frames with stationary or rotating blocks, convertible for patenting or galvanizing installations.



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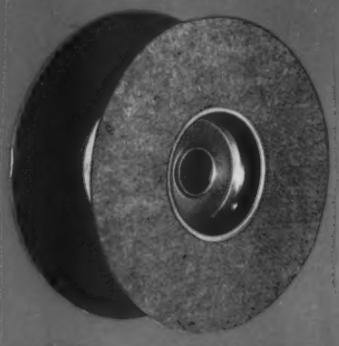

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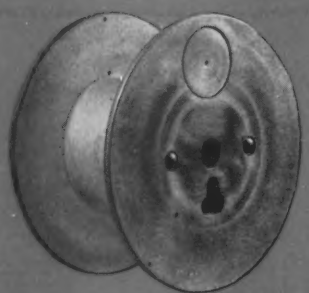

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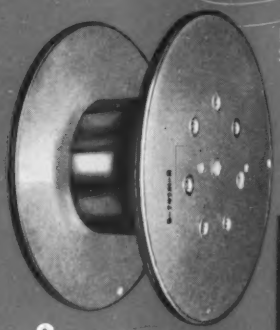

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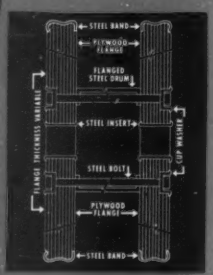


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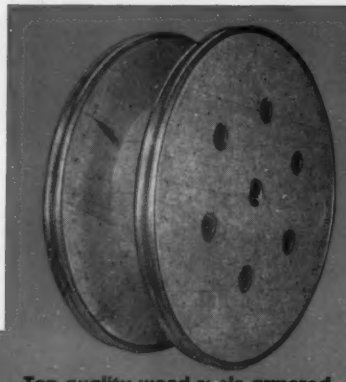

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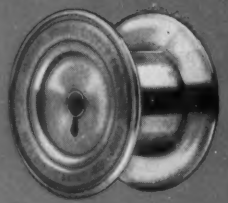

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# The Wire Outlook

Welcome to the 28th Annual Convention of The Wire Association!

While the Association was organized in 1930, the first convention was held for three days starting on June 17, 1931. There were at that time 185 members, the technical sessions offered 12 papers, and 14 concerns exhibited wire equipment. By way of contrast, this year, as for many years, the convention activities are crammed into four busy days, the membership totals nearly 1400 and some 41 technical papers are scheduled for presentation. The Association has come a long way in its three decades of existence and numbers among its members wire men in 36 free foreign countries, a goodly representation of whom will be with us this year. The more than 700% growth in membership represents an average increase of 24% a year.

The important consideration of the moment is that business is improving in most sectors. The rate of recovery from the recession, although being somewhat faster than anticipated, is now expected to be well on the way to a moderately steady upswing.

Electric power output is reaching new highs, total spending for goods and services, the GNP, was up at the close of the second quarter by 3.2 billions over the first, consumer spending for the period increased by 2.1 billions, business loans have increased and the Federal Reserve has tightened the money supply slightly and raised the discount rate—all signs of improving conditions.

Construction is a large factor in the recovery and includes both private and public building. Highway improvements this year will account for an outlay of 6.2 billions, which is 10% more than last year, according to the Federal Highway Administration. Capital outlays for roads and streets by federal, state and local agencies should be on the increase each year for the next five years. Private housing starts in July were at an annual rate of 1,160,000, the highest level in 2½ years.

While the automotive field had been the traditional biggest buyer of steel, construction has risen to become the largest consumer. In the first 6 months the auto industry took only 56% as much as a year earlier, although in June it lifted to 69%. Construction required 72% as much as in 1957 for the first half and this rose to 79% in June. The industry requires a lot of steel in the form of wire—for road reinforcement, for building and pipe reinforcement, for wire rope and a considerable amount of electrical conductor wire for power cables, motor windings, highway lighting, building wiring, etc. A good response to the new cars could give the economy a real boost, provided strikes do not curtail production.

Production of major household appliances rose in June over the volume of 1957 and radio and TV volume was up for the first time this year over preceding months.

Steel production continues to make modest gains. The aluminum industry has passed bottom and is edging up, and copper orders took a sharp up-swing in June—26%—principally accounted for by a 16,000 ton increase in purchases by the wire mills.

Fastener sales are improving, apparently due to the fact that many inventories have been depleted. One large concern states that sales at the June rate are above 1954, 20% below 1957, but 120% of the 1947-49 average. The fastener industry is a billion dollar business, comprised of some 400 concerns. Fastener sales increases normally precede a general manufacturing upturn by about 30 days.

Small gains are noted in many wire quarters, some of those besides fasteners being wire for upholstery coils and wire for springs.

A recent Dun and Bradstreet survey showed that among over 1500 interviewed, business men generally are optimistic about the trend, with the greatest degree of confidence being voiced by manufacturers of durable goods. Retailers were the least optimistic. 15% of the total interviewed looked for smaller profits, 47% expected no change, and higher profits were anticipated most often by durable goods producers. Over half foresee an improvement in new orders for the final quarter of the year.

Where there is confidence in the future, better things will be made manifest.

Edmund Duval Sickels
EDITOR

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Vol. 33 OCTOBER, 1958 No. 10

# The Manufacture of Welded Wire Mesh And Some of Its Uses

by Charles A. Kuhl
General Metallurgist
Pittsburgh Steel Company
Monessen, Pennsylvania

**The** art of electric resistance welding was discovered by **Professor Elihes Thompson** of Philadelphia in 1885 while experimenting with a spark coil operated from a bank of batteries. He accidently welded two steel rods each about ¼" diameter. Professor Thompson realized that here was a new scientific fact that could be utilized commercially. He immediately began to extend his experiment and soon built the first electric welder which was known as the Jews Harp type. This welder now reposes in the Museum of Antique Instruments and Electrical Machines at the plant of the General Electric Company at Lynn, Massachusetts. Up to this time only soft iron and the mildest steel could be welded by the blacksmith's forge. When welding mild steel by the forge it was always considered necessary to use Borax or some other flux in order to obtain a weld.

★ ★ ★

**With** the advent of this new discovery and building of an electric welder it was found that all ferrous metals could be welded by this process, all non-ferrous metals could be welded equally as well, and that any ferrous metal could be welded to any non-ferrous metal. This was undoubtedly the greatest advance ever made at any time in the art of joining together two metals of either like or unlike characters.

Charles A. Kuhl

The author is a graduate Metallurgist with a B.S. degree from the Pennsylvania State University. Immediately after graduation in 1940 he joined the Metallurgical Department of the Pittsburgh Steel Company. For them he has served in the capacities of Rod and Wire Metallurgist, Specification Metallurgist for plain carbon, alloy and stainless steels, and General Metallurgist, the position which he now holds. He is a member of The Wire Association and the American Society for Metals.

This paper was prepared for presentation at the Annual Convention of The Wire Association at Atlantic City, N. J., on October 14, 1958.

★ ★ ★

**For** a number of years after this discovery the art of electric welding made very little progress due mostly to patents being granted individual parties and the skeptical opposition to any revolutionary discovery. It seems to be human nature first to condemn any new idea and then to sit down and calmly study its advantages. With resistance welding this was done and today electric welding plays a leading role in thousands of different manufacturing processes. By 1901 **John C. Perry** had filed for a patent on a device to produce a wire fabric by resistance welding.

★ ★ ★

**The** Pittsburgh Steel Company is considered one of the pioneers in the electric welding business, starting in the month of August, 1902, to manufacture electrically

welded mesh fence. The result is that today the Pittsburgh Steel Company is one of the larger producers of electrically welded wire products exercising complete control over the manufacture from iron ore to finished products.

★ ★ ★

**In** the spring of 1919 our company started to manufacture road reinforcing for the State of Pennsylvania which was the first state in the country to use reinforcing steel fabric in concrete roads. The greatest proportion of the tonnage of welded wire fabric is used in the road paving and the construction industries. Without steel reinforcement the concrete would soon crack and crumble. There are many causes for cracking in concrete such as heavy loads, shrinkage during curing, or expansion and contraction during temperature and humidity variations. Fabric reinforcement cannot completely stop cracking, but its function is to reduce and control the frequency of occurrence. The fabric holds the cracks tightly together. This reduces the penetration of water and dirt which is the leading cause of deterioration of the cracked edges. The reinforcing wires distribute the load throughout both portions of a cracked slab by holding the edges together and taking advantage of the interlocking action of the irregular aggregate surface.

★ ★ ★

**The** increased use of the welded wire mesh for the thousands of reinforcing applications has led to many rigid specifications being written governing their mechanical properties, gauge, mesh, size, etc. The most widely used specifications are the A.S.T.M.A.82-34 and A.185-56T. Most of the other specifications issued by the State Highway Department's various city, state and other building codes, all mention the A.S.T.M. specifications or list properties that are contained in these specifications.

★ ★ ★

**The** general mechanical properties of wire for mesh listed in these specifications are as follows:

| | |
|---|---|
| **Tensile** | **70,000# P.S.I. Minimum for material to be used in mesh** |
| **Yield Point** | **P.S.I. Min. 0.8 Tensile Strength** |
| **Reduction of Area Min. %** | **30** |
| **If tensile is over 100,000# P.S.I., Reduction of Area shall be not less than 25%** | |
| **Weld Shear Test** | **(For fabric having a wire size differential up to and including 4 gauges) Minimum average in pounds, not less than 35,000 multiplied by the area of the longitudinal wire in square inches.** |
| **Bend Test** | **Shall withstand being bent 180° around a pin equal to its own diameter in sizes .3" or under, on a pin twice its diameter for sizes over .3"** |

As this is written a revision in the A.S.T.M. specification is being contemplated however, this discussion will apply to the specifications as described.

★ ★ ★

**The** type of wire drawing equipment, cost of production, mechanical properties listed, and the weldability of the wire are some of the factors that enter into the selection of the grade of steel used in furnishing to these specifications.

★ ★ ★

**The** smaller sizes are made normally from 1008 to 1010 grades of steel. As the gauge of the wire increases the carbon content of the wire normally is increased. Above .18 carbon trouble may be encountered in maintaining sound welds. If the carbon is too high the ductility of the cold drawn wire will drop.

★ ★ ★

**In** an integrated mill the Metallurgical Department has close control over the steel from the Open Hearth through all steps of manufacture to the finished mesh. Attention is paid in the Open Hearth Department to the melting of the steel to ensure clean, sound heats. Ingot moulds are cleaned and sprayed with a coating to ensure a good ingot surface.

★ ★ ★

**The** reheating of the ingots and their rolling are under metallurgical observation for the proper top cropping to eliminate pipe and other internal defects and to report on surface defects such as seams, scabs and slivers. These reports are used as a guide in scheduling the billets for reconditioning if necessary.

★ ★ ★

**During** the rod rolling an observer reports on the general condition of the rod such as surface, gauge, and ovality. These reports are relayed to the roller for any necessary mill adjustments and to aid the inspection and trimming crews who are responsible for the quality of the rods delivered to the Wire Mill.

★ ★ ★

**The** trimmed rods are sent to the Pickle House for a thorough cleaning, given a dip in cold hydrated lime and baked prior to drawing. The wire is drawn through a grease base lubricant to have a clean bright finish suitable for welding. The lubricant also contains a rust inhibitor.

★ ★ ★

**Before** being sent to the Fabric Department samples of the wire are taken for testing the mechanical properties in conformance with the specification. Each bundle is spark tested to eliminate the possibility of different grades of steel getting into the finished fabric.

★ ★ ★

**The** wire is delivered to the Fabric Department in trucks or railway cars. The average mill coil that had formerly been furnished to the Fabric Department weighed 300 pounds to 400 pounds. These coils were satisfactory as long as the diameter of wire was small. In the last few years heavier fabric welding machines have been designed and built. Larger diameters of wire could then be used to make the mesh.

★ ★ ★

**In** Column 1 of Table I are listed a few of the sizes of wire used in the newer machines. Column 3 shows how the length of wire in a 400 pound mill coil diminishes as the gauge or diameter of the wire increases. In producing fabric having 48 longitudinal wires, Column 4 lists the approximate percentage of time the machine was not operating

in a 24 hour period. This "down time" was necessary to replenish the reels and weld the ends of the coils for continuous lengths of wire.

★ ★ ★

**Machine** "down time" made it imperative that heavier weight coils be furnished. Modifications were made in the wire drawing operation to supply 2400 to 3200 pound coils. These heavier weight coils cut the "down time" to approximately 15 percent in 24 hours for all diameters.

★ ★ ★

TABLE 1. Machine "Down Time" When Using 400# Coils

| Gauge | Decimal | Length Per 400# Coil | Approx. "Down Time" Per 24 Hours For Mesh Having 48 Long Wires |
|---|---|---|---|
| 1 | .283" | 1872' | 50% |
| 2/0 | .331" | 1027' | 55% |
| 4/0 | .3938" | 967' | 60% |
| 6/0 | .4615" | 704' | 70% |
| .505 | .505" | 588' | 75% |

**Figure 1** shows some of the heavy weight coils on reels in position at the back of the fabric welding machine. The reels for the longitudinal wires are placed in rows at the back of the machine. The wires are fed through a series of straightening rolls and then passed through properly spaced guides between the welding dies. The Cross wire, from a reel at the side of the machine is fed through split dies and cut to length. Figure 2 is a photograph of the cross wire in the split guides being grasped by the receivers or "Picker fingers". The fingers move backward toward the wire and downward. Figure 3 pictures the wire placed in the proper position for welding. The dies close on the wire. Each pair of contacts is held together by a spring with a pressure varying from 600 pounds to 800 pounds depending on the diameter of the wire. The current is applied and each longitudinal wire is uniformly welded to the cross wire. The fabric then moves upward the proper distance for the next weld. The wire fabric may then be cut into sheets or furnished in rolls of specified length.

Fig. 1—Heavyweight reels for large diameter fabric wire. * * * * * * * * *

★ ★ ★

Six things must be taken into consideration for sound, uniform welding—

(1) The chemical composition of all of the wires must be similar.
(2) The hardness for all of the wires must be approximately the same.
(3) The pressure on all of the welding dies must be uniform.
(4) The wire must be clean and free of rust.
(5) The dies must all be clean.
(6) The power applied to each contact must be similar.

★ ★ ★

At the start of a run a sheet or an opened roll is checked for gauge, spacing, arrangement of wires, overhang, width, length, lay and camber. A 3 foot panel across the entire width of the mesh is sent to the laboratory for mechanical property and the weld shear tests. Periodically during the run the fabric is rechecked and a number of panels are sent to the laboratory for testing in accordance with the specification.

★ ★ ★

Cold drawn welded wire fabric is very suitable for reinforcement for concrete for the following reasons:

(1) High Tensile strength and a guaranteed yield of 56,000 pounds per square inch permits designing for a higher allowable working stress. These properties permit a reduction in the weight of steel and a decrease in thickness of the concrete slab.
(2) The accurate distribution of the steel area is assured by the welding at all intersections.
(3) The welded intersections of the cross wires with the line wires provide a positive mechanical bond with the concrete.
(4) The fabric easily takes a flat lay for reinforcing thin sections in either single or double layers.
(5) The fabric is ductile enough to be shaped into special forms. Because of the welded intersections, it is sufficiently rigid in the finished state to minimize the displacement of reinforcing members in any direction.

★ ★ ★

**The** divisions of industry that utilize welded wire mesh are:

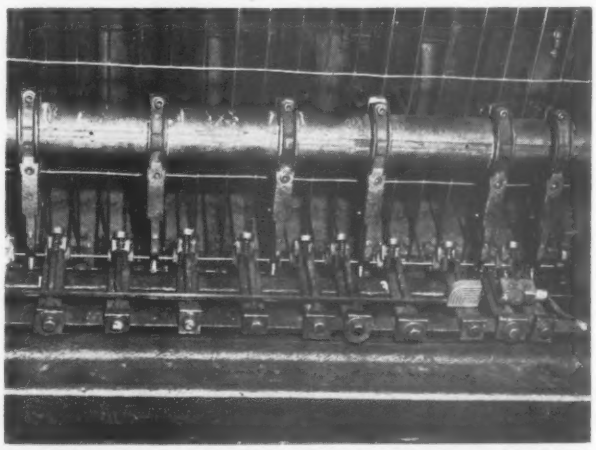

Fig. 2—Cross-wire in guides being grasped by picker fingers. * * *

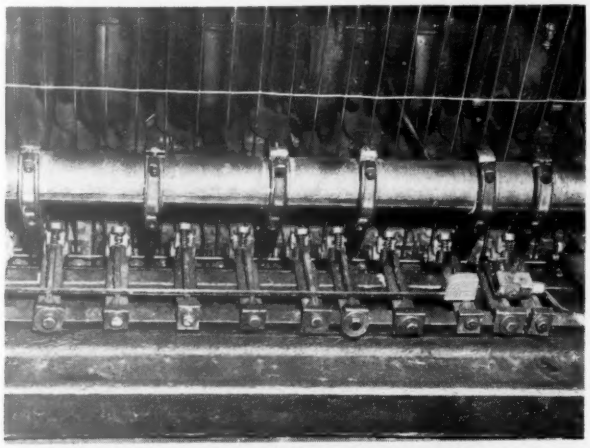

Fig. 3—Cross-wire in position for welding at fabric machines. * * *

(1) Reinforced paving
(2) Commercial and field construction
(3) Home and farm construction
(4) Reinforced concrete pipe
(5) Precast concrete products
(6) Miscellaneous

### (1) Reinforced Pavements

**In** 1919 when Pennsylvania first started to use fabric reinforcement for concrete roads, the mesh was 8 gauge plain longitudinal wires on four inch spacing and 12 gauge galvanized transverse wire on 12 inch spacing. By the spring of 1922 specifications called for a 1/0 gauge longitudinal wire and a 6 gauge plain transverse wire with 4 inch and 12 inch spacing.

* * *

**The** fabric is used also in asphalt pavement to stop the rippling that occurs under heavy traffic during high summer temperatures. Airport runways are reinforced to take the high impact and heavy loads imposed during take-offs and landings of large high-speed planes.

* * *

**Curbings** and sidewalks are reinforced to increase the length of service and reduce cost of maintenance.

### (2) Commercial and Field Construction

**Fabric** reinforcement in commercial construction is incorporated in slabs for floors, side walls, and roofs. Concrete joints for floors and roofs are also reinforced with steel fabric. Fireproof building codes require the encasing of the steel columns in concrete which is generally reinforced with Fabric. The small openings in the mesh permit a minimum thickness of concrete to meet these regulations and reduce dead weight.

* * *

**"Gunite"** is a sand and cement blend which has water added at the nozzle of the "cement gun". The mix is applied to structures by compressed air. Welded wire mesh with its small openings has been proven the most satisfactory reinforcement for "gunite" concrete. This material is not only a good fireproofing substance, but because of the air pressure application, "gunite" is very dense with high abrasion and water resistance. It serves as faces for dams and tunnels, or to repair eroded conduits, piers, and spillways. Reinforced "gunite" is applied to steel beams and columns of railroad bridges and other structures requiring a minimum of upkeep.

### (3) Home and Farm Construction

**In** home building reinforcing wire is used within concrete slabs for basement floors, walls, steps and patios. When constructing whole developments of one-story houses, contractors have devised a quick method of making walls. The forms for the four walls are laid flat on the ground with the bases next to the proper slab position. The framework contains the fabric reinforcement, the electrical conduits, and the window and door frames. Concrete is poured in the forms and hardened. The outside forms are removed and a crane hoists the walls into place. In this way much time, labor, and material are saved. Welded wire fabric reinforcement has helped to bring the cost of the home swimming pool within the reach of more owners.

* * *

**Welded** wire mesh in its most familiar form is used as fencing. The versatility of the fabric lends itself to many uses in this field.

* * *

**It** must not be forgotten that wire mesh has replaced wood lathing in interior construction. It is especially useful in supporting plaster and stucco.

* * *

**In** farm construction barn floors and foundations are being built of reinforced concrete, especially in dairy barns where sanitary codes must be met. Milk houses are easily kept clean and sanitary. Concrete feeding floors, stock watering tanks, hog houses and feed bunks all incorporate wire mesh. Poultry houses use welded wire mesh not only as concrete reinforcements in the floor and foundations, but it is also employed on horizontal wooden frameworks to prevent the chickens from walking in their litter. Turkey and poultry raisers like welded fabric in raised outside runways to keep their birds off of the ground. This cuts down losses from disease and predatory animals. Reinforced concrete silos require less maintenance, permit more even packing of silage, and provide airtight walls which prevent spoilage. Temporary silos can be built by using galvanize fabric in a circular form. This cylinder is lined with heavy waterproof paper. After filling a waterproof covering is placed on the top. Temporary grain and corn storages are made the same way. Concrete flumes and dams for water conservation have longer lives and lower maintenance costs when made with welded wire mesh. Irrigation ditches have less water loss through seepage if made from reinforced concrete or "gunite".

### (4) Reinforced Concrete Pipe

**Precast** reinforced concrete pipe is manufactured by shaping wire fabric into a cylindrical cage, precisely placing the cage between two circular steel forms, filling the space between the forms with concrete, and tamping thoroughly. The steel forms are stripped from the pipe and it is cured. The pipe is finished in diameters ranging from 12 inches to 102 inches for use in sewers and culverts.

### (5) Precast Concrete Products

**Precast** reinforced concrete in specified sizes and shapes may be incorporated in various sections of buildings such as roof slabs, floor slabs, and wall panels. Also laundry tubs and tanks are precast.

### (6) Miscellaneous

**Welded** wire mesh serves as a basis for making pallets and cargotainers. The cargotainers are baskets with pallets as an integral part of the base. They may be handled with fork trucks, singly or stacked, to save floor space. Commercial dust collectors maintain shape and rigidity by installing a wire mesh framework inside the cloth bags that trap the dust. Last but not least the welded wire mesh is used as reinforcement in the concrete burial vaults.

(*Please turn to page* 1285)

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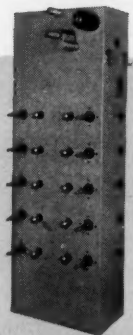

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# Inclined Enameling Machines for Coating Fine Gage Wire

by

Charles L. Erickson
Development Engineer

and

Grady Walker
Product Engineer

Tonawanda Plant
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Buffalo, New York

## Introduction

**Western Electric** has been making and using enameled wire for more years than most of us can (or maybe care to) remember. Although data on the exact beginnings of our wire enameling lie buried in the archives, we have found mention of the new Hawthorne enameled wire shop making its first commercial product in April, 1904. The enameling compound was our own concoction and contained, among other things, ozokerite, castor oil, asphaltum, kerosene, turpentine and carbon tetrachloride. The enameling machines were designed and built by us and consisted of two separate units—an oven electrically heated, and a reeling machine. Both units were circular in shape and stood about eight or nine feet high. Figure 1 is a picture of part of the fine wire enameling shop at the Hawthorne location as it appeared about 20 years ago. Twenty strands of wire were handled per machine and each strand could be given up to eight passes or coats of enamel. The wire carrying sheaves ran partly immersed in enamel contained in an open pot encircling the base of the oven.

Charles L. Erickson  Grady Walker

**Mr. Erickson graduated from Kansas State College in 1927 with a degree of B.S. in Industrial Chemistry. He worked for the Bell Telephone Laboratories from 1927 to 1936, and then went with Western Electric Company, with whom he has been continuously except for leaves of absence for military service from 1942 to 1946 and in 1951 and 1952. He is a co-developer of the machine described in this paper.**

**Mr. Walker attended Engineering School at the University of Alabama. He worked for United States Steel for 12 years, for the American Bureau of Shipping for 3 years and spent 2 years as a service and installation engineer on brewery equipment. He has been with the Western Electric Company since 1947.**

**The paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City, N. J., on October 15, 1958.**

* * *

**Operation** of these machines was more or less of an art and the quality of the product depended a great deal on the skill and alertness of a chief operator who presided over a group of nine machines. This individual would "mike" the wire frequently on the fly to check enamel increase, add enamel compound or thinner to the pot as he determined this to be necessary and was responsible for keeping the baking temperature within acceptable limits. Temperature was controlled manually. Some of these machines, modified somewhat from their original design, were still in use as late as 1948.

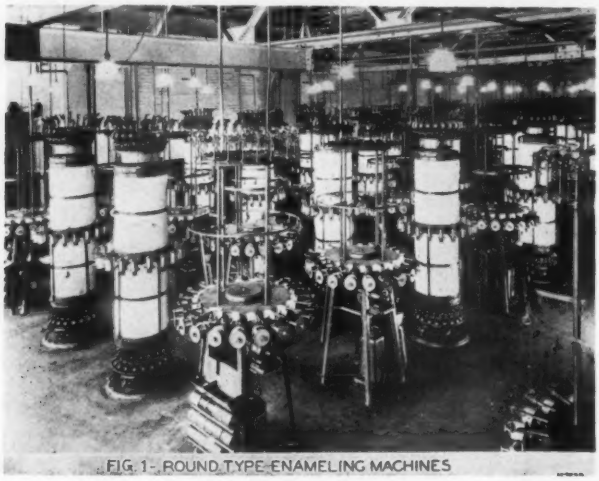

FIG. 1 - ROUND TYPE ENAMELING MACHINES

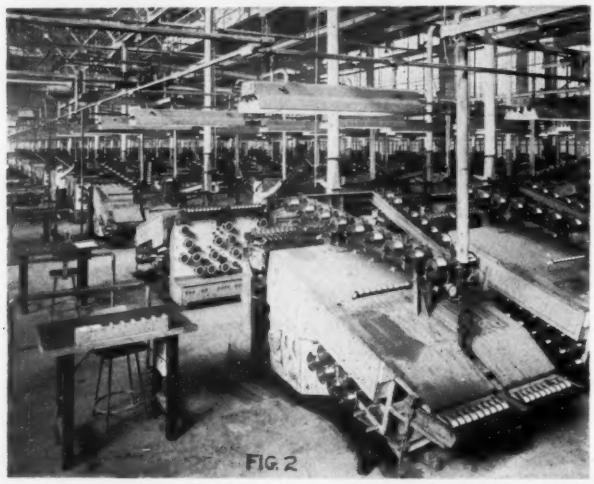

FIG. 2

Over the years and as the requirements on enameled wire became more severe, certain deficiencies in the machines became evident. Some of these were corrected, but some were inherent and could not be overcome by modification. For example, room air disturbances —especially in winter—lack of automatic temperature control, and chimney effect or stack action of the ovens themselves caused baking variations around the oven. The dip and drain method of enamel application seriously limited the speeds at which the finer sizes of wire could be processed without becoming rough or beady.

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During this time, studies had been going on at the Bell Telephone Laboratories to learn more of the basic facts governing the application and baking of enamel on wire. Researchers at other companies were also busy on the problems associated with wire enameling and articles on the subject appeared in the literature from time to time.

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With the idea of utilizing the basic knowledge obtained over the years, development work on a new enameling machine was started at the Hawthorne plant in the middle thirties. This development led ultimately to the inclined machine which is the subject of today's talk. The new machine never got into general use at Hawthorne. However, a trial installation of four machines was made, and when the wire enameling job was shifted to Tonawanda in 1947 the inclined machine became the standard production unit for fine gage enameled wire (24 to 44 gage inclusive). The Tonawanda installation consists of 88 of the inclined machines with an annual capacity of about 6¾ million pounds of wire on a seven day three shift basis. Average gage size is 37½ with 39 gage being the largest runner. This quantity stretches out to about 20,000,000 miles and requires around 125,000 gallons of wire enamel annually. At present, our product is almost entirely the oleoresinous type of enameled wire. Figure 2 is a recent picture of the fine wire enameling shop at Tonawanda which is the only Company location where enameled wire is produced.

## The Inclined Machine

Salient features of the inclined machine are:

1) A roller type of enamel applicator;
2) A rapidly circulating air stream for transferring heat from the heating elements to the baking tubes; and
3) A water seal.

★ ★ ★

With respect to the latter we have found it highly desirable to have one end of the baking tubes sealed in order to eliminate chimney effect and to minimize the effect of room air disturbances. Water was found to make an effective seal but its employment dictated that the oven be inclined. A vertical arrangement is not practical because of the fire hazard (the enamel applicator would be directly above the oven) and operating inconvenience.

★ ★ ★

The inclined machines are highly efficient and operate with a minimum of maintenance and operator attendance. Enameling speeds especially on the finer sizes are quite high (200 feet per minute on sizes 38 AWG and finer). Quality of the wire is good as measured by our own Specification requirements which are based on the properties that have been found to be desirable in wire for telephone apparatus use.

★ ★ ★

The following is a more or less detailed description of our inclined enameling machine. This machine has 18 enameling heads or channels divided into two groups of nine, the groups being spaced laterally because structural members occupy the center of the machine. For convenience the detailed description has been divided into several elements or sections.

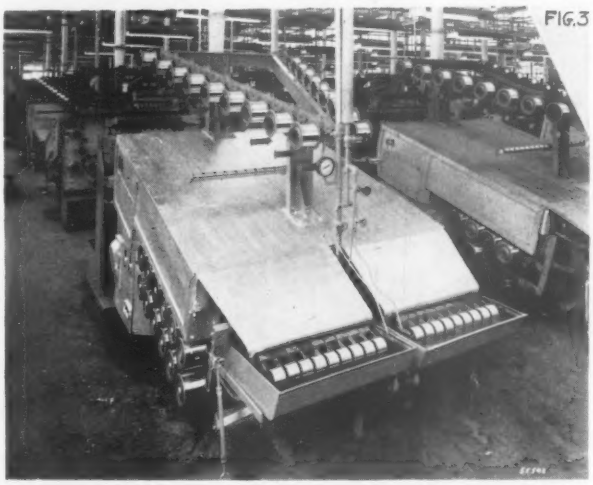


FIG. 3

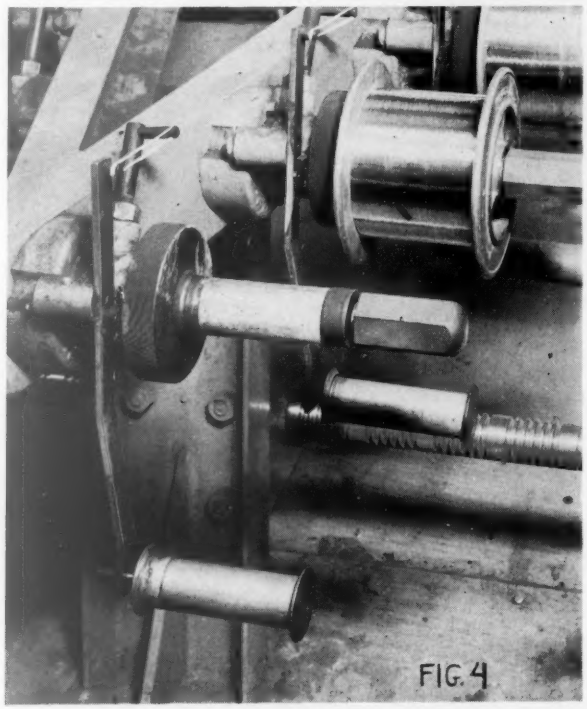


FIG. 4

## No. 1—Bare Wire Supply

**All** wire is supplied on spools which rotate as the wire is unwound. The power for spool rotation comes from the main drive capstan and is transmitted through the wire itself. In sizes 34 to 44 AWG inclusive, the bare wire is supplied on diecast aluminum spools of about 10 pounds capacity. The spools are held on special arbors affixed to a V-shaped frame mounted directly above the oven. Figure 3 is a general view of the supply arrangement and Figure 4 is a close-up of one of the special spool holders. The special arbor is equipped with an expansion device which, when tightened, grips the spool firmly but which can be released quickly so that spool changes may be made quickly and easily. The arbor carries a brake drum and a pivotally mounted lever arm. The arm carries a brake shoe on one end and a free turning roller on the other end. The axis of the roller is parallel to the axis of the supply spool. The arm is tensioned so it tries to hold the brake shoe against the drum. However, the wire being de-reeled passes around the roller so when the pull on the wire equals the tension on the lever arm the brake pressure is zero and the spool is free to rotate. Tension on the arm is supplied by ordinary No. 12 rubber bands, one or more being used depending on the gage of the wire being processed. Tension can be controlled in this manner so that the wire neither sags excessively in the oven nor stretches significantly in the enameling process.

★ ★ ★

**For** wire sizes 24 to 33 inclusive the bare wire is supplied on fabricated steel spools of about 50 pounds capacity. Running of this wire is limited to certain machines (about 24 in number) which have been equipped with auxiliary arbors. These arbors are in addition to those for the ten pound spools and are attached to frames resting on the floor directly behind the enameling machine as shown in Figure 5. These arbors are equipped with individual adjustable tensioning devices in the form of spring loaded small diameter ropes which pass over a grooved pulley on the arbor. The feed wire passes to the enameling machine on overhead sheaves so that all space around the machine is accessible.

## 2. Enamel Wire Take-Up

**Diecast** aluminum spools of ten pound and three pound capacity are used to package enameled wire in sizes 24 to 42 AWG inclusive. The three pound capacity spool, as well as a one pound capacity aluminum-nylon spool, is used for 44 gage wire. The take-up spools are individually driven by torque motors, being mounted directly on the motor shaft which is fitted with an adaptor to match the size spool being used. The adaptor has a pin drive means which permits take-up spools to be changed on the fly at speeds which range up to 200 feet per minute for the finer gages of wire. All motors (18) on a given machine are matched according to starting voltage so that wire tension is substantially the same throughout the machine. Tension can be adjusted to match wire size by means of a single powerstat which feeds all the 18 motors on one machine. The torque motor has slip characteristics that permit the spool to slow down in RPM as it becomes filled with wire.

★ ★ ★

**The** capstan assembly consists of 18 individual, one piece, stepped groove, clutch controlled, nickel plated capstans mounted on a common drive shaft. Figure 6 shows the capstan assembly and also the take-up spools. Thus each enameling head can be started or stopped without interfering with the adjacent head. Speed is set for the various wire sizes by means of change gears. A common distributor frame is located back of the

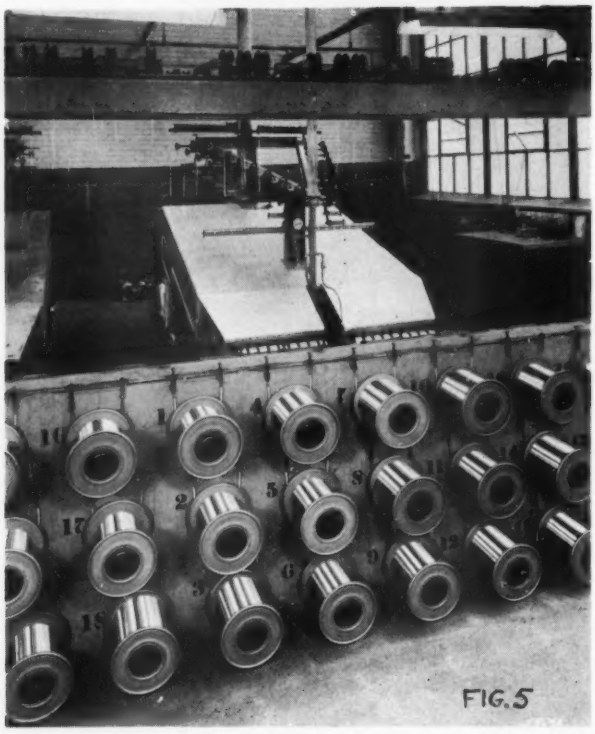
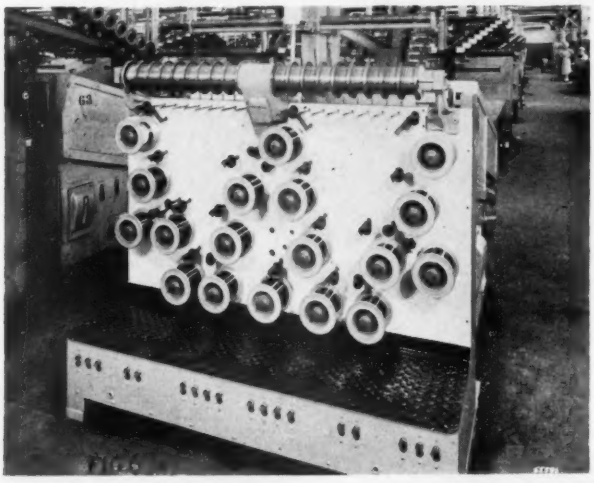


FIG. 5



take-up panel and can be adjusted for any traverse from two to eight inches. Individual distributor arms extend through the panel for each take-up spool. Each arm has a grooved wire guide pulley and an adjusting screw for centering the traverse on the take-up spool.

### 3. Enameling Oven

**Figure 3,** referred to previously in connection with wire supply, is also a good general view of the oven. The plane of the oven makes an angle of about 15 degrees with the horizontal, hence the name "inclined machine". Each enameling head or channel has its own individual tube where the enamel is baked. The tubes are oval, about 90 inches long and 2¾ inches wide. They are made of stainless steel, about .035" in thickness and are arranged in two groups of nine each. The tubes are installed side by side in a well insulated plenum chamber about 70 inches in length and 3½ inches deep. Heat is applied to the outside of the tubes by circulating heated air around them in a closed system at high velocity. Also in the system are the electric heaters and a motor driven fan. One thermocouple, located in the air stream, together with an electronic controller, keep the oven at a pre-set temperature which for the oleoresinous type of enamel we are using varies from about 800°F. to 950°F. depending on wire size being run. The electric heaters are on continuously but are switched from high or low heat as required to maintain the desired temperature. The pre-set or indicated temperature is somewhat higher than the actual temperature within the baking tubes.

* * *

**The** lower or downhill end of each tube projects from the oven proper about 18 inches and terminates under water thereby sealing the tube against the effects of room air disturbances (drafts). The enamel baking reaction requires oxygen which is supplied by admitting a small flow of air into each tube just above the water seal. The amount of air is controlled by an orifice in the inlet to each tube. Low pressure air (about two pounds) is used and is furnished by a blower driven by a 30 HP motor. The system is interconnected with the plant compressed air supply in such a manner that pressure is maintained automatically in case of blower failure.

* * *

**Located** at the lower end of each tube and partly submerged in water is a chrome plated, one piece idler or wire return sheave. This sheave is in line with the capstan and like the capstan has its successive grooves machined to slightly increasing diameters. This "stepped groove" feature prevents the wire from sagging in the tube as it expands (increases in length) from the heat of the oven. Actual stretching of the wire is insignificant.

### 4. Enamel Application

**Enamel** application is by means of a roller ¾ inch in diameter and about four feet long. The roller is articulated, consisting of six grooved sections and a smooth section, the latter being at the center of the machine where there are no baking channels. One grooved section takes care of three heads or channels. Associated with the roller is a U shaped housing or cradle having bearing surfaces for the roller projecting inwardly from the housing walls at each roller joint location. The roller is positioned so that its lower portion is below the top of the housing. The latter is maintained in an overflowing condition with enamel so that the lower portion of the roller is immersed in enamel. A close-up view of the applicator in operation is shown in Figure 7.

* * *

**The** applicator roll is motor driven through a variable speed transmission and turns in the direction of wire travel. Those por-

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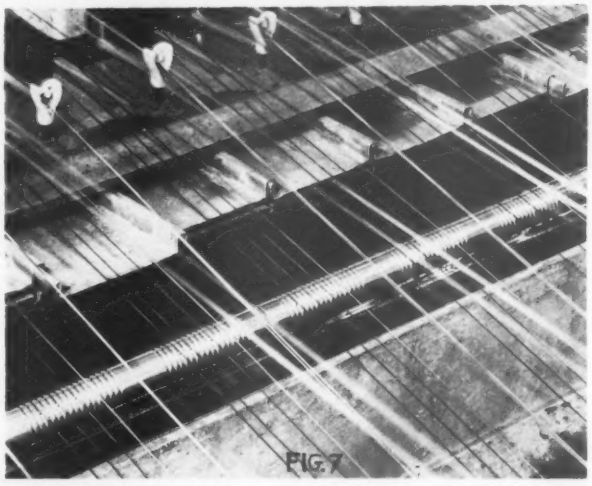
FIG. 7

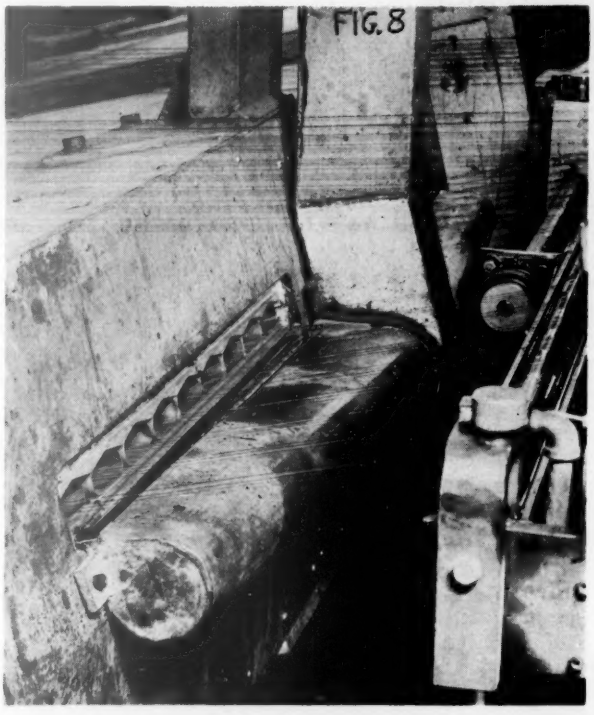
FIG. 8

# Lead Patenting of High Carbon Steel Rod and Wire

by R. H. Hertzog, Metallurgical Engineer
Steel Wire Mills Division
John A. Roebling's Sons Corporation
Trenton, New Jersey

**Patenting** in the high carbon steel wire industry is an operation whereby rod or wire—run in continuous strand fashion—is heated under proper austenitizing conditions and subsequently cooled either in air or by immersion in molten lead. The terms air-patenting and lead-patenting are common industry terminology to distinguish between the two methods of cooling. This article concerns the lead patenting process only.

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**Patenting** is essential in the manufacture of high carbon steel wire for two reasons:

1. **A microstructure is produced which is conducive to the cold flow of the steel through the drawing dies.**
2. **The tensile strength obtained in the patenting operation combined with the gain in tensile strength during cold drawing determines the final tensile strength of the finished wire.**

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**Hot** rolled high carbon rod has a microstructure which consists of free ferrite, coarse pearlite and fine pearlite. This condition results from the relatively slow cooling of the compact rod bundle after hot rolling. A 0.70% carbon rod with the microstructure described above will have a tensile strength of approximately 130,000 p.s.i. In this state, the material has only sufficient ductility to withstand approximately 65% total reduction in area by cold drawing. High carbon wire drawn within the range of ductility of hot rolled rod has neither uniform nor satisfactory properties as a finished product. On the other hand, the same rod, having been lead patented to a tensile strength of 165,000 p.s.i. prior to wire drawing, can be drawn in excess of 90% total reduction in area and will have uniform required properties. As a matter of information to those not familiar with the process of wire drawing, the reductions mentioned above are accomplished by successive continuous stages with each stage comprising a reduction of 25-30% in area.

R. H. Hertzog

**This paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City on October 14, 1958.**

**The author was graduated from Lehigh University in 1933 with the degree of B.S. in Metallurgical Engineering. After graduation he was employed by the National Tube Co., Ellwood City, Pa. from 1933 to 1941 in the Inspection and Metallurgical Departments. In 1941, he was employed by John A. Roebling's Sons Company in the Research and Development Department. In 1947, he was transferred to his present post.**

★ ★ ★

**The** gain in tensile strength due to cold drawing is appreciable. For example, a 0.70% carbon lead patented rod with a tensile strength of 165,000 p.s.i. would, when drawn to an appropriate wire size in five successive stages or "drafts", gain approximately 17,000 p.s.i. per draft and result in a final wire tensile strength of 250,000 p.s.i.

**Figure** No. 1 shows the inlet end of a wire patenting furnace and Figure No. 2 shows the quench lead unit following the outlet end of the patenting furnace.

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**The** controlled cooling or quenching of a properly austenitized rod or wire in molten lead is essentially—although not strictly—a process of isothermal transformation. By varying the temperature of the quench lead, the microstructure can be controlled which in turn controls the tensile strength. The desired components of a lead patented microstructure are ferrite and fine pearlite. The amount of ferrite and the fineness of the pearlite are functions of the carbon content and the quench lead temperature. Use of a quench lead temperature low enough to produce bainite in the microstructure is not common practice in the high carbon wire industry. Through control of the ferrite-carbide plate spacing of the pearlite by varying the temperature of the quench lead, the average tensile strength of the rod or wire can be controlled through a practical range of 20,000 p.s.i. Figure No. 3 shows the effect of quench lead temperature on the strength of a 3/16″ diameter, 0.70% carbon rod. Note that the rise in tensile strength with decreasing lead temperature levels-off at approximately 975°F and then increases again. This action is caused by the introduction of upper bainite in the microstructure. In some instances, an actual drop in strength is encountered at this point.

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**The** two basic methods of lead patenting are:

1. **Adjusting the lead temperature to obtain a desired tensile strength.**

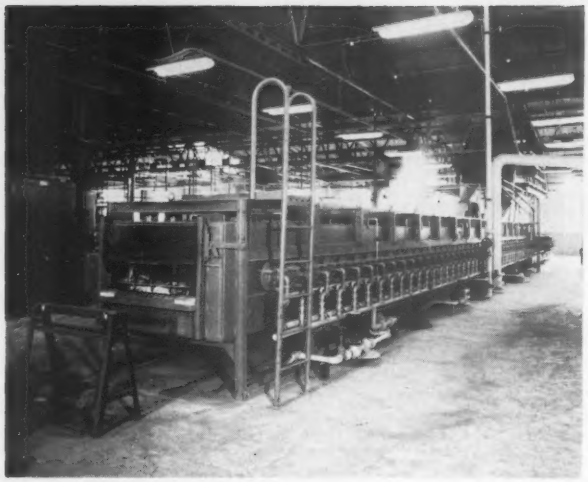

Fig. 1—Inlet end of a wire patenting furnace. * * * * * *

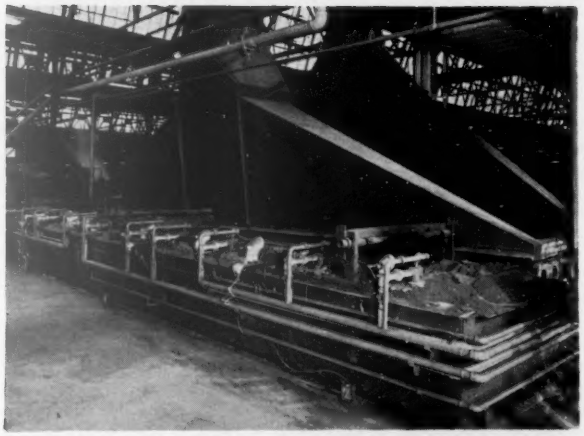

Fig. 2—Quench lead unit following outlet end of a wire patenting furnace.

2. **Holding the lead temperature constant and obtaining a variable strength.**

★ ★ ★

**The** first method has certain advantages in that a single heat of rod can be controlled within a range of tensile strengths and thus be utilized to make any one of several different tensile grades in finished wire as demand requires. The disadvantage of the method is the numerous changes in quench lead temperature that may be involved within a heat and from heat to heat. Also, the microstructures will vary with large changes in quench lead temperatures. In the second method, all material is run through the quench lead at a selected constant lead temperature. While heats of the same type of chemistry should produce similar tensile strengths under such conditions, this result is not always obtained as will be shown later. Heats which fall out of the expected pattern may not fit the production scheduling plans at that time so that stockpiling for later appropriate use is in order.

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**Until** recent years, lead patenting in the steel wire mills of the **John A. Roebling's Sons Corporation** was conducted on the basis of patenting to a desired strength by varying the quench lead temperatures. Variations in the mechanical properties of wire having varying conditions of microstructure indicated that certain constant conditions of microstructure—measured by the amount of free ferrite and the fineness of the pearlite—resulted in improved and more uniform overall wire properties. An investigation was initiated to determine which condition of microstructure was most desirable together with the necessary control to maintain such condition.

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**Sample** coils of rod varying in composition from 0.50% to 0.90% carbon were lead patented under production conditions through a range of quench lead temperatures of 975°F to 1100°F in increments of 25°F. Mechanical property tests on the various lead patented rod samples showed that elongation and reduction of area values reached a maximum in the region of 1025°F — 1050°F quench lead temperature. Microstructures in this same region were uniform and showed only small amounts of resolvable pearlite at 1000 X.

(*Please turn to page* 1288)

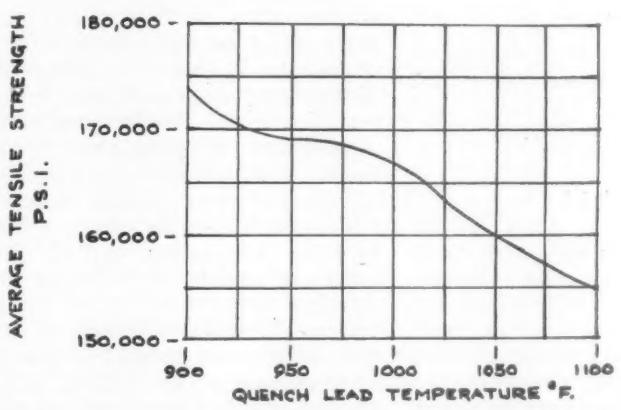


FIG. 3 - AVERAGE TENSILE STRENGTH VERSUS QUENCH LEAD TEMPERATURE FOR 3/16" 0.70% CARBON ROD

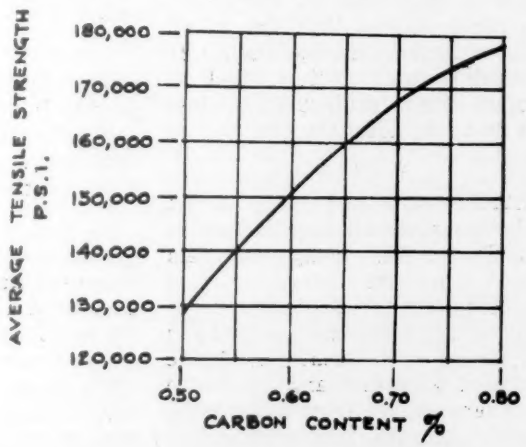


FIG. 4 - AVERAGE TENSILE STRENGTH VERSUS CARBON CONTENT FOR 3/16" ROD, LEAD PATENTED IN 1025° F. QUENCH LEAD

# Accelerated Aging Tests In Service Performance of Neoprene Jacketed Drop Wire

by

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Bell Telephone Laboratories, Inc.

Murray Hill, New Jersey

A paper prepared for presentation at the Annual Convention of The Wire Association at Atlantic City, N. J., on October 15, 1958.

**Drop** wire is a vital link in the telephone transmission system, extending the circuit from distribution cable terminals, or open wire, to the subscribers' premises. You have all seen drop wire spanning the space between the telephone pole and the house. It is used in fantastic quantities by the Bell System.

★ ★ ★

**The** current Bell System drop wire consists of two copper-steel conductors, each insulated with rubber compound of D-shaped cross section and connected by a thin fin. The two parallel insulated conductors are covered with an open cotton serve followed by a jacket of neoprene .040 in. thick.

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**Up** to 1940 the frequency of troubles in the drop wire plant was steadily increasing. Investigations made at that time to determine the cause showed that the wire's outer covering, then consisting of a weather-proof cotton braid to protect the wire insulation, was not doing an adequate job.

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**Studies** were then begun to find a better material for this outer covering. After many materials were examined neoprene was selected as being best suited for the job. Accelerated abrasion tests showed experimental neoprene jacketed wire to stand up where weather-proof cotton braid covered wire failed; the resistance of the new wire to abrasion being about 2½ times that of the old wire. The neoprene jacketed wire was exposed to simulated sunlight and rain in weatherometers and also to check tests in a less accelerated manner by outdoor exposure. In these weathering tests the new jacketed wire performed much better than the earlier braided wire. A small trial quantity of the new wire was produced late in 1941 and installed in working circuits. However, because of Government wartime restriction on the use of neoprene it was not until 1945 that regular commercial manufacture of this wire was begun. An entirely new manufacturing plant (1) was built which incorporated improved methods of handling, mixing, and processing the ingredients for producing the new wire. By the end of 1947, manufacture of the new wire completely superseded the cotton braid type of wire.

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**The** superiority of the neoprene jacket in comparison with the weather-proof cotton braid has been amply demonstrated by its service record.

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**Approximately** 6 billion feet of neoprene jacketed drop wire are in service at present, ranging in age up to 15 years. Nearly all of the older weather-proof cotton braid wire, of which there was about 3 billion linear feet in plant at the end of 1945, has been replaced. The great bulk of the cotton braid type wire was replaced during the years 1945 through 1953. During this time 5½ billion linear feet of the neoprene wire were produced of which 3 billion feet was for replacement and 2½ billion feet for growth. As shown in Fig. 1, coincident with this replacement of the older type wire there was a steady decrease in the overall drop wire trouble rate for the Bell System to half of what it was before neoprene jacketed wire was introduced: Most of this improvement can be attributed to the neoprene jacket because it has eliminated, to date, such troubles as resulted from weathering and because it has reduced abrasion, formerly a main cause of troubles, to relatively minor proportions. However, in certain areas tree abrasion of neoprene jacketed drop wire, though a small percentage in the overall drop wire trouble picture, still amounts to a lot of expensive trouble. A comparison of the causes of troubles in drop wire in the first 8 years of service in a field trial is made in Table I. In the first column are listed the causes of troubles with the former braid covered wire and in the second column is a similar breakdown of troubles in neoprene jacketed wire. A comparison of the two columns

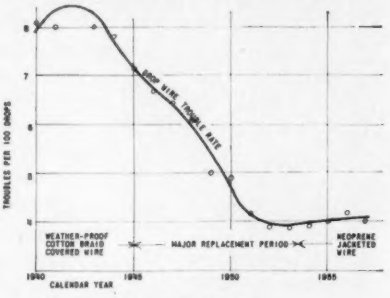


FIG. 1 DECREASE IN DROP WIRE TROUBLE RATE

TABLE I

Special Drop Wire Trouble Studies
(Troubles occurring in first 8 years of service)

| Cause of Trouble | Per Cent of Total Troubles: Braid Covered Drop Wire | Neoprene Jacketed Drop Wire |
|---|---|---|
| 1. Abrasion - Trees, etc. | 30 | 5 |
| 2. Wire Breaks - Storm, etc. | 35 | 85 |
| 3. Weather Worn - Cracking | 16 | 0 |
| 4. Clamps or Ties | 3 | 0 |
| 5. Splices | 1 | 0 |
| 6. All Other Causes | 15 | 10 |
| | 100 | 100 |

shows that wire breakage remains as about the only major cause of trouble with neoprene jacketed wire. The types of trouble that could be attributed to failure of the outer jacket, listed as Items 1 and 3 have been practically eliminated in the early service life of the wire in this limited trial area.

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**The** neoprene jacket, properly compounded and cured, protects the underlying insulation against ozone cracking, oxidation, weathering and abrasion. It is expected that failure of this jacket in service will occur eventually by embrittlement and cracking when the elongation value reaches the point (at about 15 to 20 per cent of original elongation) where the jacket can no longer be flexed without cracking. The laboratory and factory tests described later in this discussion are designed to insure that the neoprene jacket is kept at the optimum quality level for long life. The tests also serve to help predict what that life will be.

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**Except** for very short distances at terminations, the insulation is completely covered and is thus shielded from the degradation which is induced by sunlight and ozone. However, a very gradual hardening of the insulation does occur due to heat aging, especially in southern locations. Because the insulation is stuck to the conductor, the only measurement feasible to evaluate this hardening is compression resistance (the force required to cause the conductor to cut through the insulation). The change in the insulation has been found to be appreciable but not serious as shown in Table II which shows compression resistance and adhesion measured on samples exposed in California. It should also be noted that there has been no deterioration in adhesion of insulation to conductor.

TABLE II

Compression Resistance of Drop Wire Insulation Exposed in California

| | Compression Resistance, (lb) Plain | Tracer | Adhesion (lb) Plain | Tracer |
|---|---|---|---|---|
| New | 1150 | 1150 | 13 | 13 |
| Exposed 9 years | 1470 | 1460 | 16.7 | 18 |
| Exposed 12 years | 1550 | 1540 | 15.2 | 18.4 |

**The** jacket is exposed to all of the weathering elements and changes in the jacket, especially those tending toward failure, are of extreme interest. Aside from any visual evidence of surface degradation, aging of neoprene jackets can be measured by changes in tensile strength and elongation. At first, the oxygen bomb aging test was used in the laboratory as an accelerated aging test. However, it soon developed on the basis of results obtained from samples brought in from the field, that this test did not correlate with outdoor exposure. A study of air oven tests versus bomb tests reported in 1950[2] showed that air oven aging at 100°C would more nearly reproduce the deterioration encountered in the field. As a result, air oven aging at 100°C has been adopted in the Bell System as the accelerated aging test used for determining the quality of black neoprene jackets. When air oven aging is supplemented by an ozone exposure test wherein the jackets are exposed to 25 parts of ozone per one hundred million parts of air at 120°F, it is felt that a dependable estimate of serviceable life can be made. In the light of field data accumulated to date, the conclusion reached in 1950 of a life of drop wire of 20 years can be reaffirmed.

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**Two** types of black neoprene jackets are involved. Typical formulations for these are shown in Table III. The chief difference between the two is the replacement of part of the carbon black by clay. The first formulation which contains no clay represents the composition of the jacket used on the first (1941) lot of neoprene jacketed drop wire mentioned above. Some of these drops are still in service in the Atlantic City area and samples have been brought in for test from time to time. In addition, samples prepared in the laboratory with the same jacket have been tested periodically after exposure at Miami, Florida. Tables

TABLE III

COMPOSITIONS OF OLD AND NEW JACKETS

| | Old Jacket | New Jacket |
|---|---|---|
| Neoprene GN | 100.0 | - |
| Neoprene W | - | 100.0 |
| Magnesium Oxide | 7.0 | 3.0 |
| Zinc Oxide | 10.0 | 3.0 |
| Antioxidant | 2.0 | 2.0 |
| SRF Black | 90.0 | 40 - 50 |
| Clay | - | 42 |
| Plasticizer | 0.5 | - |
| Oil | 13.0 | 17.8 |
| Wax | 3.0 | 8.0 |
| Sulfur | - | 1.0 |
| Retarder | 0.5 | - |
| Accelerator | - | 15 |
| Stearic Acid | 1.0 | - |

**Erratum: The figure 15 following Accelerator in Table III should read 1.5.**

IV and V show the tensile properties measured on samples from Atlantic City and Miami respectively.

TABLE IV.

"Old" Jacket Exposed at Miami, Florida

| Duration of Exposure | Tensile Strength (psi) | Per cent Elongation | Per cent of Original Elongation |
|---|---|---|---|
| 0 | 2220 | 335 | 100 |
| 1 year 2 months | 2540 | 195 | 58 |
| 4 | 2215 | 140 | 42 |
| 6 2 | 2410 | 150 | 45 |
| 7 3 | 2450 | 130 | 39 |
| 9 1 | 2520 | 120 | 36 |

TABLE V

"Old" Jacket Exposed in Atlantic City, N. J. Area

| Duration of Exposure | Tensile Strength (psi) | Per cent Elongation | Per cent of Original Elongation |
|---|---|---|---|
| 0 | 2220 | 335 | 100 |
| 5 years 4 months | 2485 | 185 | 55 |
| 6 6 | 2615 | 175 | 52 |
| 8 6 | 2810 | 175 | 52 |
| 11 1 | 2670 | 160 | 48 |
| 12 4 | 2800 | 180 | 54 |
| 13 6 | 2140 | 145 | 43 |
| 15 1 | 2185 | 140 | 42 |

The sample exposed for 12 years in Miami could not be tested, because in this wire there was no barrier between the insulation and jacket. Removal of the jacket, which was at best difficult, became impossible in this case of greatly reduced elongation. However, this 12 year sample showed surface de-

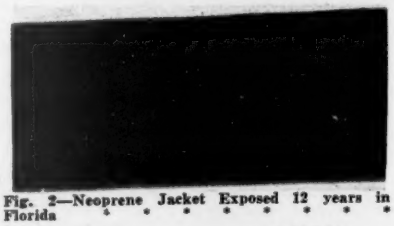

Fig. 2—Neoprene Jacket Exposed 12 years in Florida

(*Please turn to page* 1284)

WELCOME
ALKALI
IKE

# WIREMEN!

Just as it takes . . .
numerous grains of sand to make
a fine beach —

So over the years, it has taken
numerous happy customers to
establish our good position in
The Wire Industry.

*It will be our pleasure to welcome you in our suite at Chalfonte-Haddon Hall during the Convention.*

# The Thermal Embrittlement of Stressed Polyethylene

by

J. H. Heiss and V. L. Lanza

Bell Telephone Laboratories Inc.

Murray Hill, New Jersey

This paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City on October 14, 1958.

**Since** the introduction of high density linear polyethylenes, considerable interest has arisen in the use of these materials in wire and cable technology as well as in other applications. Earlier observations have shown the tendency for high density polyethylenes to crack open when heated in a stressed condition[1,2,3,4,5]. This stress-induced cracking, which is temperature dependent, is commonly referred to as thermal embrittlement. The elimination of this phenomenon is of paramount importance if these unusually strong, tough polymers are to assume a favorable position in wire and cable applications.

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**Since** stressed polyethylenes can exhibit brittle failure also as a result of an environment or through oxidation, this report will deal briefly with these phenomena. Experiments indicate that brittle failure is initiated in thermal embrittlement, environmental stress-cracking and oxidation of polyethylene by different mechanisms. Thus polyethylenes are sensitive to several competing reactions, any one or combination of which can obviate use of a particular polymer. All these effects then must be considered to achieve a more complete understanding of these destructive mechanisms. The experiments undertaken in this preliminary study were designed to differentiate among these proposed mechanisms. The knowledge gained would then be useful in suggesting possible alterations in molecular configuration to eliminate these deleterious effects.

## Experimental

**In** the measurement of thermal embrittlement three different tests were employed. The first test consisted of helically wrapping three 5″ x 0.25″ x 0.05″ strips of polyethylene around a 6.5″ x 0.25″ diameter rod of brass or polystyrene and fastening the ends as shown in Fig. 1. The assembly was then placed in a suitable glass tube containing oxygen, nitrogen or distilled water. This procedure will be referred to as the wrap-around test. In order to minimize or, preferably, divorce competing reactions, choice of a particular medium was made so that a single mechanism would predominate.

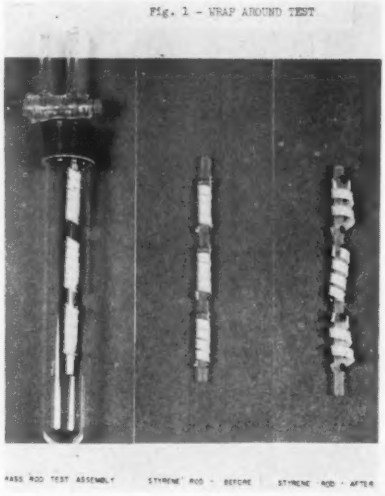

Fig. 1 - WRAP AROUND TEST

BRASS ROD TEST ASSEMBLY STYRENE ROD - BEFORE STYRENE ROD - AFTER

**The** second test consisted of wrapping polyethylene-insulated wire around itself so as to form a tight coil (Fig. 2). The wrapped wire was then exposed to the desired medium. This procedure will be referred to as the wire-wrap test.[1]

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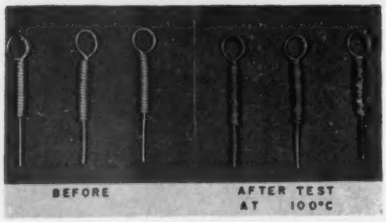


Fig. 2—Thermal Embrittlement of Polyethylene Insulated Wire.

**The** third test was a modification of the "ASTM Proposed Method of Test for Environmental Stress-Cracking of Ethylene Plastics".[6] To determine thermal effects the specimen thickness and temperature were varied and tests were run both with and without the controlled imperfection and in various media other than Igepal CO-630. This procedure will be referred to as the bent-strip test. (To study the specific action of an environment on stressed polyethylene the above ASTM test was also used essentially as written and it will be referred to as the environmental stress-crack test.)

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**An** $F_{50}$ symbol, which is used throughout this report, is the time required for 50 per cent of the samples to fail, with similar connotation applied to an $F_{100}$ symbol.

## Results and Discussion

**Initially** a series of experiments was run with an uninhibited 0.96 density polyethylene of 0.54 melt index. Specimens die-cut from molded sheet were helically wrapped at room temperature around ¼ inch rods as described in the wrap-around test. These stressed specimens were placed in ovens at various temperatures from 23°C. to 120°C. with either water or ethylene glycol acting as a heat

transfer medium (the effect of the composition of the heat transfer medium on cracking was found, in tests run at 85°C., to be about the same for both water and ethylene glycol). The total time for initiation of flaws and their propagation to definite transverse cracks was designated as the cracking time under set conditions of temperature. The logarithm of the cracking time was plotted against the reciprocal of the absolute temperature and the linear relation shown in Fig. 3 was obtained. It is surprising that these experimental points conform, as well as they do, to linearity because the discernment of what constitutes a definite crack is rather difficult.

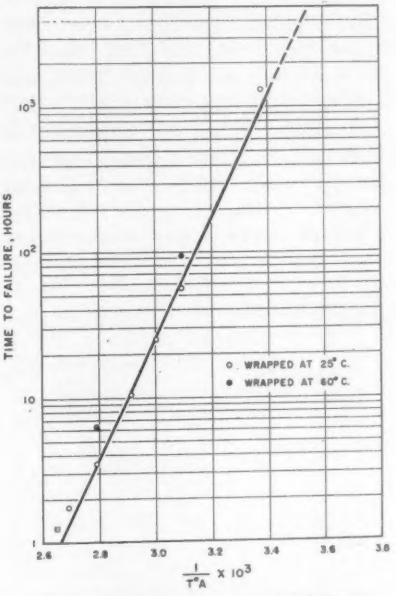


FIG. 3 EMBRITTLEMENT TIME VS TEMPERATURE FOR HIGH DENSITY POLYETHYLENE

In these thermal embrittlement experiments a flaw first appeared as a very small white dot which is characteristic of a discontinuity in refractive index and acted like a small scattering center. This white area grew with time at a set temperature and, as it enlarged, a small crack appeared within this region. The crack was always found to be transverse to the direction of the applied stress and propagated in this same direction. The thermal embrittlement initiation always occurred within the edge boundaries of the specimen and did not appear to be notch sensitive as in the case of environmental stress-cracking.

In an attempt to dissociate specific effects of water, stressed specimens of the same polyethylene were exposed separately to the action of air and water in the wrap-around test at 70°C. It was found that cracking occurred in both media in about the same time. Since air and water showed similar effects in this test, it is presumed that water functioned solely as a heat transfer agent, thereby adding further weight to the purely thermal mechanism.

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At this stage of investigation it could not be concluded that oxidative cracking had not occurred. An attempt to segregate the oxidative effects was made by performing a series of wrap-around tests with the same high density polyethylene which contained no antioxidant and duplicate samples which were stabilized with Santonox R. The stressed samples were placed in test tubes and were thoroughly evacuated and flushed with either pre-purified nitrogen or oxygen. Control samples were tested in air. The test tubes containing the stressed specimens were heated in an oil bath at an average rate of about 1.5°C./min. All specimens whether in air, oxygen or nitrogen, inhibited or uninhibited, cracked within the same time interval of 56 to 59 minutes. The temperature of the surrounding gaseous medium was between 116°C. and 118°C. Thus, it does not appear that oxidation is a prime factor in these experiments but, again, purely thermal mechanisms are operative.

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A similar series in both air and nitrogen was tested by placing samples in an air oven controlled at 150°C. Continuous observation was made while the specimens were heating. It was found that all specimens cracked badly in about 19 minutes at a temperature below which any melting was apparent. (A thermometer with its bulb near the air specimens read 120°C.)

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Noting that fairly rapid heating caused sufficient changes to induce cracking, the next experiment involved extreme measures in the rate of heating. Helically wrapped strips were shock-heated by immersion in ethylene glycol at 150°C. It was found that stress release occurred extremely rapidly, thus allowing the polymer to melt in about two minutes without cracking. A portion of these relaxed samples was allowed to cool quite slowly through the crystalline melting range, while others were shock-cooled by removing from the 150°C. environment and immediately plunging them into a dry ice-methanol mixture at —78°C. Both sets were then tested in water at 70°C. for a period of over three months and no visible cracking occurred. It would appear that these post thermal treatments have little effect on embrittlement once stress has been released.

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Additional tests using a somewhat different technique were started in an attempt to gain further qualitative information on thermal embrittlement. Environmental stress-crack tests were run at the same time for comparative purposes.

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Experiments were carried out with a 0.96 density polyethylene of 0.60 melt index protected with approximately 0.02 per cent of Ionol. Sheets of 0.075 inch in thickness were molded in which the cooling time through the melt (170°C. to 70°C.) was varied from 5 minutes to 6 hours. The density of the molded sheets, as noted in Table I, was determined by the method outlined in ASTM D1505. A series of bent-strip tests with notched specimens was run in water at 23°C. and 70°C. Similar specimens were exposed to 20 per cent aqueous Igepal CO-630 at 23°C. in the environmental stress-crack test. Cracking times are summarized in Table I.

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The same high density polyethylene further protected with 0.1 per cent of Santonox R was molded to 0.050 inch under the same conditions of time and temperature. Specimens were tested in water in the wrap-around test at both 50°C. and 70°C. Cracking data are also summarized in Table I.

TABLE I

EFFECT OF COOLING TIME ON ENVIRONMENTAL STRESS-CRACKING AND THERMAL EMBRITTLEMENT

| Time of Cooling During Molding | Density at 23°C.(g/ml.) | Environmental Stress-Cracking $F_{50}$ at 23°C. (Hours) | Thermal Embrittlement: Bent-Strip Test $F_{50}$ at 23°C. (Hours) | Bent-Strip Test $F_{100}$ at 70°C. (Hours) | Wrap-Around Test $F_{100}$ at 50°C. (Hours) | Wrap-Around Test $F_{100}$ at 70°C. (Hours) |
|---|---|---|---|---|---|---|
| 5 Minutes | 0.9618 | 160 | 2200 | 21 | 120 | 20 |
| 2 Hours | 0.9705 | 287 | 2200 | 21 | 120 | 20 |
| 4 Hours | 0.9715 | 530 | 2200 | 21 | 120 | 20 |
| 6 Hours | 0.9740 | 445 | 2200 | 21 | 120 | 20 |

**Examination** of Table I shows that virtually no effect on thermal embrittlement was produced by the large differences in cooling time. As will be discussed later, it is believed that in this high density polymer the total crystallinity and accompanying spherulitic structure is of such high magnitude that even in the rapidly cooled specimens there were many sites of inherent weakness randomly distributed throughout the polymer. While annealing, with accompanying increase in crystallinity, apparently produced many more weak sites, there was no discernible difference in cracking time. However, the effect of annealing on environmental stress-cracking was quite pronounced. The polymer cracked in significantly longer periods of time when cooled very slowly with an apparent maximum cracking time for the four hour sample. The reason for the increased resistance to environmental stress-cracking with longer annealing time is not clear. It is believed that the slow cooling through the crystalline melting range is critical and produces a higher modulus material (increased crystallinity) with a more homogeneous internal stress. Thus, there are fewer regions of stress discontinuity compared with those regions in the rapidly cooled specimens. It is this variation in internal stress over a rather short range which produces flaws leading to penetration of either molecules of water or of surface active agent; the surface active agent possibly serving to wet the polyethylene to allow penetration of water. These polar molecules can then substitute for molecular bonding energies, which are of low order in polyethylene, causing further weakening and eventual destruction.[7] Again referring to Table I, it is seen that at 23°C. the cracking effect of the environment was much greater than that produced thermally. With increasing temperature it appears that the environmental effect is overshadowed by the thermal effect which becomes the dominant factor. However, the important fact to consider is that these high density polyethylenes do develop destructive cracks at room temperature.

## Other Polymers

**Several** other ethylene polymers and a few copolymers covering a broad density range were studied using the wrap-around test in water at 70°C. (Table II). For comparative purposes environmental stress-crack tests were also run in accordance with the ASTM procedure.[6] It is seen that for a constant melt index as the basic crystallinity is decreased, the tendency to embrittle thermally is decreased. For example, polymers A, B, and C possessing approximately the same melt index and presumably the same average molecular weight show a decreasing time to failure with increasing density. The resistance to environmental cracking, however, is unchanged over this fairly narrow density range. Certainly large increases in crystallinity result in a higher modulus material which will have higher stresses when deformed to a constant strain. This has a pronounced effect in the environmental stress-crack test in which the specimens are non-constrained. Other factors such as molecular weight and molecular weight distribution can be of even greater importance in environmental cracking while they are probably of lesser importance in thermal embrittlement. It is shown in Table II that increasing molecular weight leads to increasing resistance to thermal embrittlement. For example, polymers A and G have practically the same total crystallinity but the melt index indicates that polymer A has a significantly higher molecular weight and shows greater resistance to thermal embrittlement. This apparent difference in molecular weight produces a greater than ten-fold increase in environmental cracking resistance.

TABLE II

THERMAL EMBRITTLEMENT AND ENVIRONMENTAL STRESS-CRACKING OF OTHER ETHYLENE POLYMERS

| Polyethylene | Melt Index at 190°C. | Density* at 23°C. (g/ml.) | Thermal Embrittlement At 70°C. $F_{100}$ (Hrs.) | Environmental Stress-Cracking in Igepal CO-630 $F_{50}$ at 50°C.(Hrs.) |
|---|---|---|---|---|
| A. Low Pressure | 0.12 | 0.9483 | 240 | 130 |
| B. Low Pressure | 0.12 | 0.9514 | 172 | 130 |
| C. Low Pressure | 0.14 | 0.9551 | 148 | 130 |
| D. Low Pressure | 0.47 | 0.9500 | 120 | 12 |
| E. Low Pressure | 0.45 | 0.9505 | 72 | 30 |
| F. Low Pressure | 0.62 | 0.9472 | 48 | 13 |
| G. Low Pressure | 0.74 | 0.9502 | 48 | 12 |
| H. High Pressure | 0.92 | 0.9345 | No Failures in 2200 | 3 |
| I. High Pressure | 1.39 | 0.9270 | 1250 | 28 |
| Ethylene Copolymers | | | | |
| J. Low Pressure | 0.71 | 0.9265 | No Failures in 2200 | No Failures in 2200 |
| K. Low Pressure | 0.74 | 0.9415 | 2000 | 230 |

*Density of molded sheets used for test

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**The** anomalous behavior of polymer D with respect to the other polymers in this series is not understood. Qualitative ideas may be presented but more work comparing thermal embrittlement in nitrogen and water is needed for a more complete understanding. It must be remembered, however, that one phenomenon can presumably

enhance the other. Thus, in the environmental stress-crack tests reported, it is quite possible that some of the samples failed due to a combination of both effects.

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It is also interesting to note that the two ethylene copolymers studied had good resistance to thermal embrittlement. These copolymers also had greater resistance to environmental stress-cracking.

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An apparently anomalous feature of the experiments noted in Table II was the fact that polymer I embrittled although its density was only 0.9270. This apparent deviation from the normal behavior of low density polyethylenes presented a rather perplexing problem. Did, in fact, this polymer really thermally embrittle? In an effort to explain this phenomenon, a series of wrap-around tests was run in sealed tubes with polymer I using oxygen, water and nitrogen as media at 70°C. and 100°C. and in addition glycerine and Igepal CO-630 at 100°C. It was found that at 100°C. cracking occurred in water at 18 hours, in glycerine at 50 hours, and in Igepal CO-630 at 1¼ hours. However, the samples in nitrogen, both at 70°C. and 100°C., have been under test for over three months without any signs of cracking. The sample in oxygen at 100°C. showed signs of yellowing followed by the appearance of liquid decomposition products and eventually failed at 1200 hours. At 70°C., however, this sample has not failed after four months of test. Subsequent examination of polymer I revealed it to contain only a moderate amount of antioxidant. There can be little doubt that the sample in oxygen embrittled due to oxidation. It is also apparent from the tests in nitrogen that polymer I does not have a tendency to embrittle thermally. All the evidence suggests that perhaps polymer I stress-cracked in both water and glycerine although these reagents are generally believed to be innocuous. Polymer H, by comparison, was uninhibited, had a low dielectric loss, was not affected by water and did not thermally embrittle.

A series of wetting experiments was run on freshly microtomed samples of polymers H, I, the high density (0.96) polymer and a typical low density (0.92) polymer. The measurements were made with a Gaertner telemicroscope fitted with an ocular protractor. It was found that polymer I in contact with water exhibited a contact angle of less than 90°, while the low and high density polymers along with polymer H had a contact angle greater than 90°. Although these experiments were semi-quantitative, the measured difference in contact angle between polymer I and the low density polymer, which was some 10°-15°, was sufficiently large to preclude experimental error. It has recently been confirmed that polymer I contains a relatively high percentage of polar groups accounting for its high dielectric loss and possibly for its unusual wettability. It is believed, therefore, that polymer I did, indeed, stress-crack in water and in glycerine due to intimate surface contact. Further, polymer H, which was not wetted, has not cracked after 3 months in water at 100°C.

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A hypothesis has been evolved which may possibly explain the thermal embrittlement phenomenon. It is based on changes in molecular arrangement with accompanying changes in the spherulitic structure. Within a sheet of high density polyethylene of approximately 90 per cent crystallinity there are regions of crystallites randomly arranged and interspersed with more orderly alignment in spherulitic form. Spherulites are large ordered arrangements of crystallites which are produced by an assemblage of crystals radiating from a nucleation point. Throughout the crystalline region is distributed roughly 10 per cent of amorphous material. These molecules apparently act as a shock-absorbing medium under high-speed impact and a plasticizer under low rates of stressing. When a strip of this type of polyethylene is bent, as in the wrap-around or bent-strip test, it is believed that the stress induced in the section under tension causes an elastic deformation in the structure of the spherulites. For example, if two spherulites are lying adjacent to each other the applied stress causes a slight separation and distortion of these ordered bodies. This causes crystallites to be removed from a more stable to a less stable state. The elastic forces are sufficient to overcome the viscous drag component and eventually the crystallites will restore to approximately their initial state. Thus, with time, contraction to the more perfectly ordered structure takes place. This restoration might be total crystallite movement as a single entity or destruction and reformation at some other point in space. This places the newly formed crystallite in approximately the same energy relationship as the original crystallite before displacement. It is believed that this proposed tendency for elastic restoration causes very high but extremely local order stresses to be set up between crystallites which are being pulled back in opposite directions into their respective spherulites. The net result will be the formation of sub-microscopic flaws at or near the stressed surface which will no longer sustain the induced stress. Whether the flaw occurs in the inter- or intracrystallite region is unknown, but in no way does this conflict with the proposed hypothesis.

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This hypothesis implies that thermal embrittlement should be a rate reaction which is dependent upon the temperature of test. This is confirmed by the data presented in Fig. 3 in which cracking occurred at temperatures just below the softening range down to 23°C. It is indicated that this is not a reaction taking place at some minimum value of energy, but rather a fairly smooth change in viscous drag which permits the structure to assume a lower energy arrangement. It is possible that at some low temperature the internal viscosity might be too high to allow this reaction to take place.

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Presumably, if high density polyethylenes are stressed in the molten state, the elastic restoring forces would be practically eliminated by viscous flow. Thermal embrittlement would not take place

under these conditions. Some further evidence was obtained in connection with this latter point. If thermal embrittlement is, indeed, associated with molecular relaxation, then the temperature at which the polymer is strained should alter the distribution of relaxation times. An air oven, controlled at 60°C., was employed to condition and wrap specimens of the same uninhibited high density polyethylene (Fig. 3) in the wrap-around test. The specimens were cooled to room temperature, submerged in water and then placed in air ovens at 50°C. and 85°C. Comparative results to specimens wrapped at room temperature showed the following behavior:

| Temperature of Wrapping | Time to Failure $F_{100}$ (Hours) at 50°C. | at 85°C. |
|---|---|---|
| 25°C. | 56 | 3.5 |
| 60°C. | 94 | 6.3 |

★ ★ ★

**The** above data for wrapping at elevated temperature are also shown in Fig. 3 for comparison with the linear plot obtained for samples wrapped at 25°C. A line drawn through these two points would show a definite shift to the left or to the longer time region. Also, the slope appears to be altered toward a lower value. These data, coupled with those of the rapidly heated stressed samples where analogy to molten wrapping is evident, constitute a definite pattern. As the relaxation time is shortened, the applied stress decays more rapidly until a temperature is reached where stress can no longer be sustained. Evidently when these conditions are fulfilled, thermal embrittlement is no longer a destructive phenomenon.

## Modified High Density-Low Pressure Polymer

**If** thermal embrittlement is a function of stresses due to total crystallinity and accompanying spherulitic size, it should be possible to decrease total crystallinity by mixing high density polyethylene with another polymer such as low density polyethylene. To investigate this possibility, wrap-around tests were run with various mixtures of a high density (0.96) and either of two low density (0.92) polyethylenes of different molecular weight. All materials were stabilized with 0.07 per cent diphenyl paraphenylenediamine to minimize oxidative effects and all tests were run in water at 70°C. Environmental stress-crack tests were run at the same time for comparative purposes. The results are summarized in Table III.

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**Examination** of Table III clearly demonstrates that as the crystallinity in the physical mixtures is decreased, as shown by density measurements, the time to failure is increased presumably until the mixture will no longer thermally embrittle. There also appears to be very little difference in the behavior of mixtures containing either typical low density-medium molecular weight or high molecular weight polyethylene. This evidence supports that presented earlier (Table II) in demonstrating the importance of total crystallinity in the thermal embrittlement phenomenon. While this phenomenon is also sensitive to molecular weight changes the difference in molecular weight between the two low density polyethylenes used was presumably not great enough to affect the thermal embrittlement time of their respective mixtures.

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**It** is most significant to note that the environmental stress-crack results did not parallel the thermal embrittlement results. In fact, rather interesting reversals are noted. For example, the high density polymer failed in two hours in the thermal embrittlement test and had an $F_{50}$ of 10 hours in the environmental stress-crack test. The 25-75% mixture of the high density and the low density-medium molecular weight polyethylene did not fail in the thermal embrittlement test after three months but had an $F_{50}$ of only 0.5 hours in the environmental stress-crack test. Similarly, samples of wire insulated with the same low density-medium molecular weight polyethylene have shown no cracks after greater than three months in the wire-wrap test at 50°C. although the strain is calculated to be 50 per cent in the wire-wrap test as compared with a calculated value of 15-16 per cent in the wrap-around test. There are many other examples of this behavior pattern which strongly suggests that different mechanisms are operative.

TABLE III

THERMAL EMBRITTLEMENT AND ENVIRONMENTAL STRESS-CRACKING OF MODIFIED HIGH DENSITY POLYETHYLENE

| Composition | Melt Index at 190°C. | Density* at 23°C.(g/ml.) | Thermal Embrittlement at 70°C. $F_{100}$ (Hrs.) | Environmental Stress-Cracking in Igepal CO-630 at 50°C. $F_{50}$ (Hrs.) |
|---|---|---|---|---|
| 100% High Density P.E. (Control) | 0.87 | 0.9593 | 2 | 10 |
| 75% High Density P.E. + 25% Low Density Medium M. Wt. P.E. (M.I. ≅ 2.0) | 0.90 | 0.9491 | 48 | 4.9 |
| 50% High Density P.E. + 50% Same Low Density Polymer | 1.1 | 0.9393 | 1450 | 8.3 |
| 25% High Density P.E. + 75% Same Low Density Polymer | 1.4 | 0.9295 | No Failure in 2200 | 0.5 |
| 100% Same Low Density Medium M.Wt. P.E. | 2.0 | 0.9195 | No Failure in 2200 | 0.3 |
| 75% High Density P.E. + 25% Low Density High M. Wt. P.E. (M.I. ≅ 0.3) | 0.64 | 0.9488 | 48 | 8.2 |
| 50% High Density P.E. + 50% Same Low Density Polymer | 0.48 | 0.9390 | 500 | 12.0 |
| 25% High Density P.E. + 75% Same Low Density Polymer | 0.37 | 0.9280 | No Failure in 2200 | 6.8 |
| 100% Same Low Density High M.Wt. P.E. | 0.3 | 0.9195 | No Failure in 2200 | >3000 |
| 95% High Density P.E. + 5% Butyl Rubber (Enjay Butyl 217) | 0.88 | 0.9587 | 6 | 12.0 |
| 90% High Density P.E. + 10% Butyl Rubber (Enjay Butyl 217) | 0.87 | 0.9565 | 2 | 13.0 |

*Density of molded sheets used for test.

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**It** is well-known that the addition of 5 or 10 per cent of butyl rubber to low density polyethylenes greatly increases their resistance to environmental stress-cracking.[8] However, the negligible effect of the addition of butyl rubber to the high density (0.96) polyethylene (Table III) is understandable. It appears that butyl rubber, which contains a high proportion of pendant methyl groups, is not compati-

ble with the linear high density polymer and thus cannot function to cushion the highly crystalline polymer. This was confirmed by measurements which demonstrated that the hardness of the 0.96 density polymer did not change with the addition of either 5 or 10 per cent butyl rubber. However, as the total crystallinity of polyethylene is decreased and the polymer molecules assume a branched structure more closely related to butyl rubber, compatibility increases and is reflected in increased resistance to thermal embrittlement. For example, the addition of 5 per cent butyl rubber to polymers A and G (from Table II) resulted in a threefold increase in time to embrittle thermally. Hardness measurements on these mixtures show a decrease of from 2 to 5 per cent.

## Conclusions

**The** findings of this study indicate that there are three separate and distinct phenomena which can initiate brittle failure in polyethelenes. The mechanisms involved are oxidative, environmental, and thermal in nature, and can act singly or in concert depending upon the type of polyethylene and the conditions of test.

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**An** hypothesis is proposed for the thermal embrittlement mechanism in which an applied strain results in an elastic dislocation of crystallites from their lower energy spherulitic arrangement into an adjacent higher energy arrangement. The elastic forces of restoration overcome the viscous drag component leaving points of inherent weakness in the gross structure which leads to eventual brittle failure. This mechanism is a temperature-time dependent reaction and is purely thermal in nature.

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**Oxidation,** with its accompanying chain scission and gelation, is also a rate reaction which can lead to brittle failure.[9]

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**Environmental** stress-cracking, which is highly dependent upon the physical state of the polymer and requires a contact medium, appears to be a substitution of some of the intermolecular forces in polyethylene by the medium which allows the molecules to separate. The resultant flaw, which concentrates the applied stress, results in destructive cracking.

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**Factors** which apparently influence the brittle failure of polyethylenes are average molecular weight, molecular weight distribution, branching, total crystallinity (specifically as related to spherulitic formation) and purity. The important factor in thermal embrittlement appears to be total crystalline structure, while in environmental cracking, molecular weight and molecular weight distribution appear to be more important. On the other hand, the number and type of branches in the polymer appear to be the major factor in oxidation behavior.[10,11,12] However, if the polymer is synthesized such that excessive carbonyl groups are incorporated into the polymer structure or catalyst residues are not completely removed, oxidative processes are enhanced.[9] Further, the incorporation of excessive polar groups in the polymer may affect environmental cracking by reducing the polyethylene-liquid contact angle.

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**In** the spectrum of polyethylenes, the high density polymers are far more susceptible to thermal embrittlement than are the low density polymers which are not greatly affected. Physical mixtures of these can be produced which greatly minimize the tendency to embrittle thermally although this is accomplished only at the sacrifice of the physical properties which make these high density polymers outstanding. Based upon our limited experimental results, it appears that it may be possible to copolymerize ethylene with some other monomer to yield a high density copolymer which would have a greatly minimized tendency to embrittle thermally and at the same time retain many of the desirable properties unique to high density polyethylenes.

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**The** results of our experimentation further point out very markedly the necessity for extreme care in assessing the results obtained and their categorization under any one single mechanism. For instance, if environmental crack-testing is to be applied to high density polyethylenes, the greatly increasing magnitude of the thermal effect with rise in temperature can completely overshadow the rate of entry of any liquid media. Oxidative reactions can be made negligible by the incorporation of suitable antioxidants into the polymer, while thermal effects can be segregated by testing in a vacuum or a medium of prepurified nitrogen. If water is used as a heat conducting medium, there may be cases where surface wetting and subsequent environmental cracking may take place before any possible thermal or oxidative effects are noted.

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**Based** upon the results obtained with the polymers studied to date, use of high density polyethylenes in wire and cable applications appears to be, at best, quite questionable. However, use of post-formation treatments such as irradiation may prove useful in eliminating this destructive phenomenon. Further, with the rapid rate of technological advance in the polyethylene and hydrocarbon polymer and copolymer fields the same goal may be attained in the near future.

## Acknowledgement

**The** authors gratefully acknowledge enlightening discussions with Drs. W. O. Baker and W. P. Slichter and should like to thank Dr. W. L. Hawkins, Messrs. W. M. Martin, C. R. Glenn and B. D. Moore for their alliance in many phases of this work.

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(*Please turn to page* 1285)

# A Modern Order Entry and Invoicing System

by

T. W. Harman
Manager of Orders

and

J. C. Farrell
Asst. Manager of Orders

Union Drawn Steel Division
Republic Steel Corporation
Massillon, Ohio

**Republic Steel Corporation** recently completed an installation of a teletype order entry and invoicing procedure. This installation was accomplished by the use of an order form suitable for use on teletype equipment in all District Sales Offices, Division Service Centers, Mill Service Centers and Mill Billing Offices plus a Central Control Switching Center in Cleveland.

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**The** Sales Order Form is the key document in the integration of order entry and invoicing systems within Republic. From this single form are derived sets of common information which simplify paper handling. A list of the functions of this order will show how, through integrated design, the order has become the basis of many documents. The functions of the order form are:

T. W. Harman

**Mr. Harman joined Union Drawn in 1923 as a correspondence clerk in the Order and Service Department. He is familiar with all phases of this work having served as assistant manager for six years prior to his appointment as manager. He co-ordinates the activities of the operating and sales departments to see that customers get the steel they order on schedule.**

**Mr. Farrell has been with Union Drawn for seventeen years, except for three years in the U. S. Army Air Force. His career parallels that of Mr. Harman.**

**This paper was prepared for delivery at the Annual Convention of The Wire Association in Atlantic City, New Jersey, on October 15, 1958.**

1. **A sales order**
2. **A specifications control card**
3. **A salesman's reference**
4. **A schedule card**
5. **An acknowledgment**
6. **An automatic order entery tabulation source**
7. **A mill order**
8. **A mill tag**
9. **A shipping notice source**
10. **A certification of tests source**
11. **An invoice source**
12. **An automatic shipment tabulation source**

★ ★ ★

**These** functions are accomplished both by form design and by the use of teletype tape. The tape exactly reproduces from document to document the data on the original form. The design of the form is determined by all the functions of the form; the sequence on the sales order form is the sequence on all other documents.

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**The** following is an explanation of the order entry and invoicing procedure:

★ ★ ★

**On** receipt of a customer's order at the District Sales Office, a sales order is typed automatically producing a teletype tape on a teletype processing unit which consists of a keyboard teletype machine and a tape reperferator. The tape reperferator not only punches a teletype tape but also prints on the teletype tape which is then used to transmit the order to one of six Division Service Centers, Carbon Bar, Carbon Flat Rolled, Pipe, Alloy, Cold Finished or Wire Products. By having a teletype printer wired into the transmitter, copies of the sales order for internal use in the District Sales Office are automatically reproduced at the time of transmission to the Division Service Center. After transmission, this teletype tape is filed by a reference number to be used for repeat orders for the same item from the same customer. This eliminates the manual typing of repeat orders except for variable information such as weight, de-

(*Please turn to page* 1281)

J. C. Farrell

NEWS OF INTEREST TO THE WIRE AND CABLE INDUSTRY VOL. III, No. 5

# WIRE Recorder

T.M. REG. U.S. PAT. OFF. MONSANTO CHEMICAL CO.

PUBLISHED BY MONSANTO CHEMICAL CO., PLASTICS DIVISION, SPRINGFIELD, MASS.

## New Moistureproof Package for Monsanto Black Polyethylene Compounds

It is not uncommon for wire and cable manufacturers to experience difficulties caused by moisture in extruding black polyethylene compounds particularly during the humid summer months. Excessively high moisture content may cause porosity, "blows," heavy die build-up, poor surface appearance, formation of bubbles under cable sheaths or next to conductors, or a combination of these effects.

Both polyethylene manufacturers and wire mills have found it necessary in the past to adopt a number of precautionary measures designed to reduce the possibility of excessive moisture pickup. Compound manufacturers have attempted to hold the initial moisture content of black polyethylenes to a very low level and to keep minimum inventories to prevent extended storage times. Wire extruders generally have adopted a first-received, first-extruded materials handling system. Many have installed hopper driers, which have proven to be of considerable assistance. Often, however, even using one or both of these safeguards has not completely eliminated moisture problems, which condition has forced the wire manufacturer to run at greatly reduced rates and/or to resort to drying the compound in an oven. This latter operation is both inconvenient and time-consuming, as illustrated by Figure 1, which shows

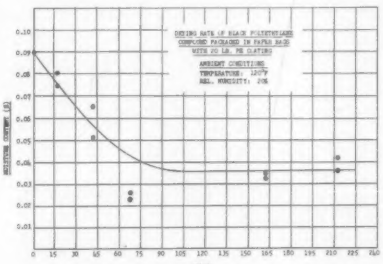

*Figure 1*

the time required to reduce the moisture content of a single bag of polyethylene to an acceptable level to be some 50–60 hours.

It is well known that carbon black contained in black polyethylene compounds is the source of the moisture

(*continued on page 4*)

*These polyethylene bags have been adopted as the standard package for Monsanto black polyethylene compounds 11302 and 14202. Its performance in the field to date has confirmed its expected superiority.*

## St. Lawrence Seaway — Gigantic Power Project

The St. Lawrence Seaway, a huge shipping and power project that will float cargoes across the North American continent from as far west as Minnesota, is rapidly nearing completion on the U.S.-Canadian border. In addition to its enormous aid to transportation, the project will also result in more than 1½ million kilowatts of power for the cosponsoring nations within the next year.

A cooperative project of the New York State Power Authority and the Ontario Hydro-Electric Power Commission, the Power Project will create more power at cheaper rates for industries and for commercial and residential use in large areas of each of the countries involved. The completion of the Seaway will bring a new surge of hydro-electric power to the states of New York and Vermont as well as to the Province of Ontario. Consumers throughout the area can look forward to a 10% to 25% reduction in the cost of their electric power.

With the completion of each stage of the Seaway Project, new industrial and economic expansion programs are announced for the states and provinces that line its banks. By April 1, deep-water ore carriers will be able to bring their ore directly to many of the steel mills that are located along the Great Lakes. Several of the cities in this area are already engaged in projects to deepen and enlarge their inland harbors to accommodate these ocean-going vessels. New highways are also under construction in many of these states to transport cargoes from lake ports to other nearby midwestern cities.

The new power will make it possible for industry to expand in the

(*continued on page 4*)

MONSANTO WIRE RECORDER
newsletter

NEMA WIRE AND CABLE SECTION CONDUCTS RESEARCH ON NEW PRODUCTS - A new program has been instituted by NEMA to study the potentialities of high-temperature insulated wire. Included in the study are hook-up wire, coaxial cable, and air-frame wire of 150°C and higher. The first step in the project will be to determine vital statistics and field requirements.

* * *

U.S. ELECTRIC POWER TO BE 21% NUCLEAR BY 1980 - According to predictions of the National Planning Association, reduced costs in atomic power will be an important factor in the building of more nuclear power plants. Current estimates indicate that 75% of all electric-producing plants will be atomic-powered by 1980. The Association anticipates the production of at least 7.8 billion kilowatt-hours of nuclear power annually by the year 1965.

* * *

$1,750,000 ELECTRONIC "MORON" GOES TO WORK FOR BOSTON BANK - Despite the versatility and high rate of speed and accuracy maintained by the new DATA-matic, electronic processing machine now in use at the First National Bank of Boston, Mr. Benjamin W. Taunton, in charge of planning the installation, refers to the electronic giant as a "moron." Mr. Taunton's deprecating terminology was applied to the highly rated electronic "brain" because of its dependence on the bank's highly trained staff of specialists who enable it to handle up to 60,000 digits a second.

* * *

ELECTRICAL POWER OUTPUT KEEPS PACE WITH GROWING DEMANDS - Recent surveys show an increase of 100% in electrical requirements every ten years. A recent report by the Edison Electric Institute indicates that electrical power throughout the U.S. is meeting and, in many instances, bettering these growing demands. At the present time the average weekly output of kilowatt-hours is in the vicinity of 12 billion, which includes 9.4% utilized in Atomic Energy Commission installations.

* * *

CONSOLIDATED EDISON BUILDS NUCLEAR POWER PLANT ON HUDSON - A new nuclear-fueled electric generator plant, now in the process of being built 24 miles north of New York City, is scheduled for completion by 1960. The new project will cost an estimated $90 million and will produce more than 275 thousand kilowatts. When completed, the operation will serve both Westchester County and New York City.

* * *

NEW FORD INSTALLATION INCLUDES NINE ACRES OF AREA LIGHTING - The new Ford staff and product engineering building at Dearborn, Michigan, utilizes 400,000 square feet of area illumination - one of the largest lighting installations in the world. Averaging approximately 90 footcandles, all lamps are well shielded and serve as integral architectural and decorative assets, acting as supports for acoustical material which also serve as reflectors for the lamps.

## Address on Electrical Resistance of Vinyl Now Available

Among the highlights of the First National Conference on the Application of Electrical Insulation was an address delivered by Mr. Mansfield W. Williams, assistant manager of the Technical Service Department for Monsanto's Vinyl Resins & Compounds.

The article entitled "Electrical Resistance Characteristics of Polyvinyl Chloride Formulations" was written by Mr. Williams and Mr. J. R. Taylor, another member of Monsanto's staff. Reprints of the address are now available without charge to readers of the WIRE RECORDER.

The theme of the conference, "Insulation — Use It Right," was given considerable emphasis during the three-day event which was sponsored by AIEE and NEMA at the Pick-Carter Hotel in Cleveland from September 3rd to 5th. With a combination of exhibits and discussions, many of the various phases and applications of all types of electrical insulation were presented. Displays by several of the leading manufacturers in the field of electrical insulation filled two floors at the Pick-Carter and attracted thousands of visitors during the three-day period of the conference.

Copies of "Electrical Resistance Characteristics of Polyvinyl Chloride Formulations," the paper delivered by Mr. Williams, may be obtained by writing to: WIRE RECORDER, Monsanto Chemical Company, Plastics Division, Springfield, Massachusetts.

## Cable Crossing Completed in One Hour

A few weeks ago a barge loaded with a huge reel of insulated submarine cable moved into the entrance channel of the harbor at Long Beach, California. The General Telephone Company of California, after months of research and planning, was ready to proceed with the laying of a 600-foot cable across the harbor bottom.

Although not an expensive project, the installation of the cable did present a variety of problems for the west coast phone company. Professional undersea divers, dredging companies and the cooperation of the local harbor commission all combined with the engineering staff of the telephone concern in completing the task.

All traffic was cleared from the harbor for the two and one-half hours

(*continued on page 4*)

## G.E. Aims to Outproduce Soviet in Power Race

The General Electric Company has announced plans to recapture world leadership in the field of extra-high voltage transmission of electricity. The Soviet Union currently leads the field in this area; however, G.E. plans to begin construction next year on a prototype system featuring a 4.5-mile power line capable of carrying 750,000 volts. The experimental line, which is to be erected near Pittsfield, Massachusetts, would be higher than any other existing line in the world and would be more than double the top voltage of lines used in the U.S. at the present time.

Dr. Pier A. Abetti, manager of system research at G.E.'s power transformer department at Pittsfield, is supervising work on the $5-million project. Dr. Abetti recently co-authored a report on the advances made in the field of electrical energy in the Soviet Union.

Dr. Abetti reported that the Russians are in the process of increasing their 400,000-volt system to 500,000, surpassing the peak capacities of other European nations such as Germany, France, Finland and Sweden. The grid covered in the Soviet system comprises some 1,000 miles. It is believed that the Russians plan to build an additional 1,000 miles of 500,000-volt transmission lines during the next few years. He pointed out that the Russians also have a small experimental 650,000-volt line now in operation at 600,000 in the area near Leningrad.

The G.E. line to be built next year will begin operations by carrying between 460,000 and 500,000 volts in order to make comparisons with existing European grids. During the second and third year of the project, power will be raised to 600,000 and eventually 750,000 volts. The 750,000-volt line will be capable of supplying all the power requirements of a city having a population of one million people. It is considered probable that the final voltage to be reached will be one million volts.

Many of the accessories for the Pittsfield installation are already under construction. According to Dr. Abetti, work on the project actually began nearly two years ago. In addition to the Pittsfield branch of G.E., some 15 other G.E. departments will participate in the development of the high-voltage system with the Western Massachusetts Electric Company supplying the power. By 1962 this same power will be connected to the operations of the overall system.

*MODEL TOWERS of General Electric's extra-high voltage line — which will carry power at a maximum of 750,000 volts — dwarf a 110,000-volt transmission line tower built to same scale. From the left are Julius H. Hagenguth, famed lightning expert and EHV project consultant; Lynn Wetherill, manager of engineering for the Power Transformer Department; and Pier A. Abetti, project manager.*

**New Package** (*continued from page 1*)

problem. Unfortunately, those blacks offering maximum protection against ultra-violet degradation (channel blacks with 20 millimicron maximum particle size) also exhibit maximum moisture pickup. The equilibrium moisture content of cable jacketing compounds, which contain 2.5 to 3% black, may vary from less than 0.05% to greater than 0.15% depending on the ambient relative humidity, as shown in Figure 2.

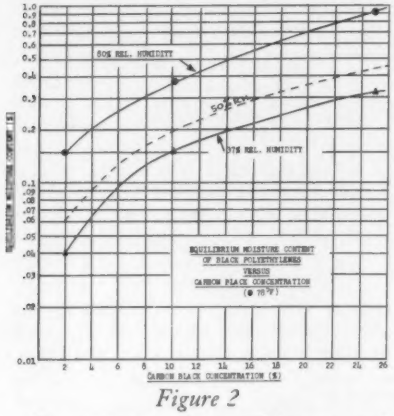
50% REL. HUMIDITY
75% REL. HUMIDITY
EQUILIBRIUM MOISTURE CONTENT OF BLACK POLYETHYLENES VERSUS CARBON BLACK CONCENTRATION (@ 70°F)
CARBON BLACK CONCENTRATION (%)

*Figure 2*

To overcome the troublesome and costly moisture problem, Monsanto has developed an all-polyethylene bag for packaging of black compounds. This bag is made from 10 mil polyethylene film and is heat sealed after filling to insure exclusion of moisture. Figure 3 illustrates the greatly improved protection against moisture offered by this package. It can be seen that the moisture content of black jacketing compound packaged in polyethylene bags remains below 0.05% after 150 days' storage, whereas compound packaged in standard polyethylene-coated paper (Multi-Wall) bags exceeds 0.05% within some ten days after manufacture. Storage times of up to 200–250 days are currently felt to be feasible with polyethylene bags. The impermeability of this package is so good as to permit nearly two months' storage with the filling spout left unsealed, as could occur with a partially used bag.

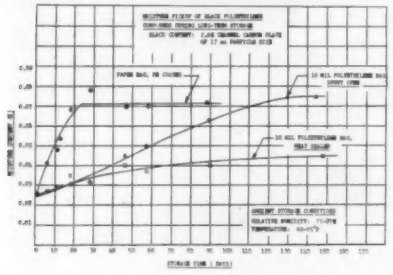

*Figure 3*

Other features of the 10 mil polyethylene bag of interest to cable manufacturers are its greater toughness and easy openability. Thus, there is less breakage and spillage both in transit and in the cable mill. Also, because of the complete absence of paper fibers, lint, and strings, contamination levels should be reduced. The bags themselves may be reclaimed for use by the wire manufacturer or sold as scrap film.

## Airways Plan for Jet Age

The Airways Modernization Board is deep in plans and actual construction for a new age in air transportation. The rapid development and recent introduction of jet airliners into the field of commercial air travel has necessitated drastic changes in the facilities and operations of existing airfields and equipment.

The Board's current program, scheduled for completion by 1962, involves some $50 million, part of which will go toward the rehabilitation and equipping of a National Aviation Facilities Experimental Center near Atlantic City, New Jersey. With the AMB's major interest centered on electronics, the wire and cable industry can expect a considerable degree of involvement in future moves by the Board. Navigation equipment that will include an air-borne device that offers continuous indication of position as well as steering information, memory and computing facilities is already in production.

A new project being supervised by the Civil Aeronautics Administration will determine the accuracy of ground aid stations. Eventually the AMB plans to combine the facilities of these ground stations with air-borne navigation units for complete accuracy.

Communications and data processing facilities are two other areas scheduled for drastic revisions to accommodate the new aircraft. At the present time U.S. airports at Idlewild in New York, San Francisco and Los Angeles are already radar-equipped to accommodate jets.

**Seaway** (*continued from page 1*)

rural northeastern corner of New York State, and for Vermont to supply added electricity to both private homes and local industries.

A huge power dam at Barnhart Island has already started operations with eight of its eventual thirty-two generators producing electrical energy. When completed the total output of all power facilities along the Seaway will be divided evenly between the two participating nations.

As a source of employment the over-all project has at times employed as many as 6,000 workers on a single phase of the operation. The top employment figure at any single time totaled more than 22,000 men and involved hundreds of pieces of equipment and machinery from as far away as England and France. The final work on the project will not be completed for many months; however, both the U.S. and Canada already have started receiving dividends from this gigantic project that has turned the border between the two nations into a source of energy, transportation and income for both.

**Cable** (*continued from page 3*)

needed to do the job. The cable was first threaded through an opening in the concrete embankment of the harbor, then along a ten-foot ditch to a vault reached through a manhole where it was safely secured. Once this part of the job was set, the deep-sea diver was ready to begin his assignment. On the harbor bottom the cable was securely lashed to a piling to hold it in position. The next step called for the cable to be clamped to steel sheet pilings. This was done by welding the clamps to the pilings with an acetylene torch.

A previously cleared path across the channel made it possible for the remaining cable to be stretched across the harbor and forced down into the soft bottom mud with the aid of a high-pressure water jet. Once across the harbor the cable was again run through an opening in the harbor wall, above the high watermark, where it was led into a vault beneath the manhole to be joined to the rest of the subsurface network. The cable now in place will be able to remain in constant use for many years without repairs or maintenance . . . thanks to the specially insulated submarine cable utilized for the job.

Monsanto

**MONSANTO CHEMICAL COMPANY**

**PLASTICS DIVISION—SPRINGFIELD, MASSACHUSETTS**

# The Progress of Mechanical Descaling In England

by H. F. Sanderson
Wire Mill Manager
Frederick A. Power & Sons (Saltley) Ltd.
Midland Wire and Bar Mills
Birmingham, England

## Introduction

**Since** 1941, due to a serious shortage of Sulphuric Acid on the Continent of Europe, alternative means of preparing the surface of Hot Rolled Wire Rods for subsequent wire drawing, other than by the pickling method, became a necessity and mechanical descaling by means of rollers and brushes was introduced in France to be used in line with the continuous drawing of Low Carbon Steel Wire.

★ ★ ★

**In** the beginning, the results were far from encouraging. The resultant die wear, coupled with frequent wire breakage, terminated with an output that was uneconomical, to say the least, but out of necessity the process was persevered with and after years of experiments, chiefly with die angles and lubricants, this procedure became more generally used, although without actually attaining the standard of surface finish and output as that obtained by drawing from pickled rods.

★ ★ ★

**In** 1951 a threatened shortage of Sulphuric Acid in England resulted in some Wire Manufacturers trying the French procedure for mechanical descaling as an alternative to pickling.

★ ★ ★

**Although** the knowledge derived from the French experiences helped to give the English producers a more helpful jumping-off ground, the results they obtained from the use of this practice were not entirely satisfactory, chiefly by virtue of the fact of low output arising from machine stoppages through wire breaking and also greater die wear than that obtained when using pickled rods.

H. F. Sanderson

**This paper was delivered at the Annual Convention of The Wire Association at Atlantic City, New Jersey, on October 14, 1958.**

**The author commenced an Apprenticeship in Cold Drawing Toolmaking in 1918 at The Sheffield Forge & Rolling Mills Ltd., Sheffield, England, from where he moved in 1930 to Fredk. A. Power & Sons Ltd., Midland Wire & Bar Mills, Birmingham, England, where he was in charge of Tool and Die Developments.**

**In 1940 he was promoted to the position of Production Manager, and in 1944 he was made Wire Mill Manager.**

**During the past 6 years he has made a close study of the process of mechanical descaling of hot rolled wire rod with the object of discontinuing the use of acid, at least in part, and so reduce the disposal of spent liquor to a minimum.**

★ ★ ★

**Drawing** speeds had to be considerably reduced to attempt to overcome the excessive die wear and also to reduce the wire breakages caused through the wire becoming embrittled by virtue of the fact of the action of the scale breaking rolls which produced a wire in the early stages of drawing that had a higher tensile value than that of wire drawn from pickled rods.

★ ★ ★

**Difficulty** was encountered in producing certain finished wire products from mechanically descaled wire, but this was eventually overcome.

★ ★ ★

**At** first only Low Carbon Rods were drawn by this method, but now High Carbon Rods containing up to 1.0% Carbon are being successfully drawn.

★ ★ ★

**The** high finishing speeds attained when drawing from pickled rods have not been achieved with mechanical descaling, but quite a number of wire manufacturers in England have found the process to be suitably allied to their own particular production ranges.

★ ★ ★

**I** will now describe in detail the extent to which mechanical descaling is being used, together with data showing results arrived at through observations made during a prolonged period of initiation of the mechanical descaling process to the practical production lines now in use.

## Suitable Rods For Mechanical Descaling

**Apart** from the usual recommendations regarding the suitability of the absence of Spills and Slivers, which applies to all Hot Rolled Rods for Cold Drawing, what is most important is the condition of the scale, both from its constituent values and its manner of adherence to the

virgin metal, particularly where the rod is intended for Mechanical Descaling.

★ ★ ★

**The** condition of the scale has been the subject for considerable research in England at high level and it is still being studied, but we have proved in practice that a rod which has been finished at a reeling temperature of 1560°F has a more suitably scaled surface for Mechanical Descaling than one finished at a reeling temperature of 1650° or higher.

★ ★ ★

**Also** at the lower temperature reeling the scale on the outer laps of the rod coil are more favourable for Mechanical Descaling than the laps within the coil.

★ ★ ★

**These** inner laps having cooled more slowly have a scale that is twice as heavy as the scale on the outer laps.

★ ★ ★

A scale with properties that make for tighter adhesion to the virgin metal is also a result of slow cooling and is not as well suited to Mechanical Descaling.

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**No** difficulty presents itself when drawing wire from Patented Rods as these have the ideal surface, which is provided by the set cooling arrangements for Patenting and a more uniform scale is formed throughout the coil.

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**At** present, although the request for low temperature reeling is agreeable to the Rod Roller, difficulty of slow cooling within the coil remains a deterrent to achieving an ideal. With the possibilities of controlled cooling for Patenting in line with rod rolling, the same cooling arrangements may be allowed to furnish the desired scale condition on Mild Steel Rods for Mechanical Descaling.

## Types of Descaling Machines

**Several** types of machines are being used. These are fitted with scale-breaking rolls, followed by brushing or wiping arrangements.

**A** simple twin roll machine is chiefly used in line with multiple block machines for continuous drawing and a more elaborate set-up, which uses as many as 16 rolls followed by a brushing arrangement, is used with single pass drawing blocks where the product requires a surface finish suitable for marketing.

★ ★ ★

**The** Twin Machine does not provide for a finish on the wire at the first two passes suitable for trading as Bright Drawn because the slight oxide skin left after descaling is still in evidence.

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**It** is essential for continuous drawing after mechanical descaling that this oxide skin is not disrupted until adequate lubrication has been achieved. This is taken care of at the first pass by using a proprietary brand of lubricant applied under pressure which provides a coated wire suitable for further cold drawing. After the first pass, normal lubrication such as that used with pickled rods is used, if a bright surface finish is required, but wire being drawn down for intermediate heat-treatment is produced to its ultimate base size by using the proprietary brand of lubricant which does ensure a longer die life than more conventional drawing soaps.

★ ★ ★

**The** slight oxide skin diminishes with the elongation of the wire and after the first two passes the usefulness of the wire for wire products is not impaired.

★ ★ ★

**The** Twin Roll Machine is not power-driven. The rolls are revolved by the rod being passed over them and the inlet speed of the rod synchronizes with the drawing speed of the first block which is usually in the region of 250/300 feet per minute.

★ ★ ★

**The** machine has rolls so positioned that the wire rod, when passed over them, is bent on two separate planes at right angles to each other.

**The** first trials were carried out with a machine that had rolls positioned to bend the wire on three planes.

★ ★ ★

**This** latter type of machine sets up an initial hardening of the wire rod more readily than the twin roll machine, which is now in more general use.

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**Following** the operation of scale breaking by rolls, a final brushing arrangement was incorporated with this machine.

★ ★ ★

**Experience** has proved that this brushing arrangement is unnecessary when continuous drawing is being carried out and only a light wiping arrangement is required to remove any oxidial dust that remains loosely attached to the rod after passing the scale breaking rolls.

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**Quite** a number of lines are running with only the Twin Roll arrangement immediately in front of the first draw-block lubricating box.

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**Other** users feel that some carry over of the oxidial dust impairs the lubricant properties and they have installed a light wiping arrangement after the rolls, which incorporates a small revolving drum packed with a textile material through which the rod passes before entering the lubricating box.

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**The** machines being used with single pass draw blocks are more exacting in their preparation of the rod surface. After passing the rod over two sets of rolls, each set comprising from six to eight rolls, positioned to break the scale on two planes at right angles to each other, the rod is passed through a brushing apparatus which provides a surface that is suitable for single block drawing, but not so favourable to continuous drawing, as this latter process requires a prepared rod surface that will absorb a drawcoat.

**Rods** up to .400" diameter are being processed for single block drawing, which provides a surface suitable for numerous wire products.

★ ★ ★

**Wire** intended for cold heading which requires a coat suitable for extrusion has not been produced by this method because of difficulty in applying the requisite coat to the polished wire surface, which is the result of the brushing operation, whilst drawing in line with mechanical descaling.

## Lubrication

**The** most difficult problem presenting itself with the application of the Descaler was in finding a suitable drawing lubricant for continuous wire drawing.

★ ★ ★

**This** had to be applied to the wire rod which had a surface that was totally different from a pickled rod. It was necessary that it supplied two essentials to the process of continuous wire drawing.

★ ★ ★

**First,** a suitable coat similar to that of Sull-Coated or Phosphate-Coated Rods had to be provided between the Descaler and the first die.

★ ★ ★

**Second,** essential lubrication had to be achieved.

★ ★ ★

**The** lubricants supplied with the Descaling Machines from France were found to be very expensive in comparison with the usual sodium soaps and also very uneconomical by virtue of the fact that much shorter die life was obtained with their use, and the slower drawing speeds introduced to overcome this resulted in lower tonnage output.

★ ★ ★

**Over** a period of 6 months, commencing with the first installation of the Scale Breakers in England, numerous types of lubricants were tried, each achieving a gradual improvement.

★ ★ ★

**Finally,** a drawing compound was produced costing the same as the usual Sodium Soaps with such an improved performance that even longer die life than that obtained with pickled rods was obtained.

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**To** illustrate this a continuous run was given on two identical machines using wire rods of the same gauge and quality and drawing by equal drafting to the same finished size.

★ ★ ★

**One** machine using Sull-Coated Pickled Rods and the other mechanically descaled rods.

★ ★ ★

**The** machine using the Sull-Coated Pickled Rods with the normal Sodium Soap as lubricant changed dies over twice as often as the machine using the Mechanical Descaler, together with the newly developed coating lubricant. Afterwards when the Sull-Coated Rods were drawn with the new Coating Lubricant the die life was equal to that of the Mechanical Descaling practice.

★ ★ ★

**This** lubricant is now being used universally for Continuous Wire Drawing and is the chief reason for the success of the Mechanical Descaling Machine.

★ ★ ★

**During** the 6 months trials the experiments with lubrication were carried out with the assistance of a manufacturer of wire drawing lubricants and the newly developed product became a proprietary brand.

★ ★ ★

A further improvement in the application of the lubricant has recently been achieved by applying it under pressure by means of a specially designed tube situated immediately in front of the first die.

★ ★ ★

**When** at first the lubricant was developed it was manufactured in a coarse granular condition and this was applied by means of a Vee-shaped Propulsion Roll in the Lubricating Box, but more recently it has been manufactured in a fine granular condition which, together with the pressure tube, has given a much improved performance.

**Lubrication** for single block drawing is made with the usual Sodium Soaps or Graphited Grease.

★ ★ ★

**As** previously stated, Wire requiring a Stearate coat or similar for extrusion processing, is not drawn in line with this type of mechanical descaling.

## Drawing Speeds

**With** new wire drawing techniques that are being continually introduced to make possible faster and faster drawing speeds, it is difficult to fix an up-to-date standard by which comparisons can be made between the speed of drawing wire from pickled rod and that of wire drawn from mechanically descaled rod, but it has been proved that the speed of the first wire block should not exceed 300 feet per minute for the successful use of the mechanical descaling method. This is the practice preferred when the Twin Roll descaling machine is being used. Inefficient descaling and inadequate lubrication is the result if this speed is exceeded.

★ ★ ★

**This** is our usual speed required to commence the continuous drawing of 5 SWG rods, so there is no disadvantage in using the descaler at this stage.

★ ★ ★

**The** following are finishing speeds that are being used in conjunction with mechanically descaled rods:

**Low Carbon Steel Rods**
**5 SWG to 10 SWG at 900 ft. per minute**
**5 SWG to 17 SWG at 1800 ft. per minute**
**60% Carbon Green Rod**
**5 SWG to 12 SWG at 900 ft. per minute**
**80% Carbon Patented Rod**
**5 SWG to 14 SWG at 1100 ft. per minute**

★ ★ ★

**The** finishing speeds of Low Carbon Steel Wire are slightly less with mechanical descaling than those of wire drawn from Pickled Rods, but the speeds being used for finishing High Carbon Steel Wire are comparable with those of pickled rod drawing and are accepted as eco-

(*Please turn to page* 1278)

# Wire Insulation of "Teflon"(R) FEP-Fluorocarbon Resin— Properties And Fabrication

by

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and

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**"Teflon"** 100X FEP-fluorocarbon resin is a new melt processable high temperature polymer which is currently available in developmental quantities from the Polychemicals Department of the Du Pont Company. The full scale commercial plant for producing this resin is under construction and will be on stream in late 1959.* The "Teflon" FEP resin should be particularly valuable to the wire and cable industry because with it, for the first time, long continuous smooth lengths of tough jacketing for cables (as well as many other wire covering needs) can be made. Such jackets are capable of continuous service at 200°C., extremely weather resistant, chemically resistant, and are non-flammable.

* * *

**(Background)** — Ten years ago the appearance on the wire market of "Teflon" TFE-fluorocarbon resins (polytetrafluoroethylene) coincided with the growing demand for a high temperature plastic insulation with unusually good electrical properties and chemical resistance. The TFE-fluorocarbon resins satisfied these requirements, and factors such as their unique resistance to weathering and to thermal aging established new reliability concepts: life measured almost in centuries was now practical even at temperatures hitherto considered high—i.e., above 180°C. (356°F.). Radio frequency uses became common also, as the high frequency insulating properties of the TFE resins have never been surpassed. Because these resins did not really melt, but became rubbery gels above 621°F., it was possible to use them for short times at temperatures in excess of 600° F.; on the other hand, the same characteristic required that special processing equipment be used. The development of "Teflon" FEP-fluorocarbon resin has therefore met a long-felt need for a resin with many of the properties of the TFE resins plus the ability to be processed in conventional plant equipment such as injection molding machines and melt extruders. Like the TFE-fluorocarbon resins, the FEP-fluorocarbon resin has a fully fluorinated structure and therefore retains hitherto unique properties of the TFE resins.

* * *

**(Properties: Thermal)** — The FEP-fluorocarbon resin differs in behavior from the TFE-fluorocarbon resins primarily at high temperatures. Whereas the TFE resins become rubbery above 621°F, (Figure 1), the FEP resin begins melting at about 545°F, and at 720°F, has about one millionth the melt viscosity of the TFE resins. At temperatures as high as 480°F, however, the FEP resin has striking tensile strength and retention of physical properties, and is serviceable continuously at temperatures up to at least 400°F under light loads (compared with at least 500°F for the TFE-fluorocarbon resins). At low temperature, the FEP-fluorocarbon resin (like TFE-fluorocarbon resins) retains useful properties to below —300°F for rigid service or below —90°F for flexing service.

FIGURE 1

THERMAL PROPERTIES

(Typical Values)

| | Fluorocarbon Resins | |
|---|---|---|
| | FEP | TFE |
| Melt point | 545°F - 565°F | 621°F |
| Melt viscosity at 720°F (shear stress - 4.5 dynes/cm²) | 6-9 x $10^4$ poise | $10^{10}$ - $10^{11}$ |
| Tensile strength, 392°F, psi | 650 | 1,050 |
| Cut-through temperature | | |
| 32 mil wire, 8-10 mil film, 340 gm. load | 522°F | 506°F |
| Low temperature brittleness (ASTM D746) | -140°F | -150°F |
| Coefficient of linear thermal expansion, -100°F to +160°F in/in/°F. | 4.6 - 5.9 x $10^{-5}$ | 6.9 x $10^{-5}$ |

**One** of the key advantages that

**Mr. Lovett's work brings him into contact with a wide range of new applications for wire insulations, especially for the field of aviation. Prior to his present assignment he held several positions in the Manufacturing Division of this department in both Wilmington and Charleston, West Va. He graduated from Yale University with a Bachelor's degree in Electrical Engineering. He also holds a Master of Science degree from M.I.T.**

**Mr. Stabler, a graduate of the University of Delaware with a degree of B.S. in Chemical Engineering, has been closely associated with fluorocarbon process development and service. From 1950 until 1956 he was in the Research Division of the department doing development work on "Athalon" and "Teflon" resins. He has written two previous papers on insulating materials.**

**This paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City, N. J., on October 14, 1958.**

*A similar schedule applies to tape of "Teflon" FEP-fluorocarbon film now available in developmental quantities from the Film Department of the Du Pont Company.

the TFE-fluorocarbon resins have offered to the wire user is the soldering of wires without damaging the insulation. The FEP resin naturally cannot match the TFE resins in this particular characteristic, but it does have adequate resistance to the temperatures attained in most soldering operations.

★ ★ ★

**(Properties — Electrical)** — The FEP-fluorocarbon resin, like the TFE resins, differs from all other standard insulations in the remarkable stability of its electrical properties over a wide range of frequency and temperature.

★ ★ ★

**(Insulation Resistance)**—Insulation resistance of the FEP-fluorocarbon resins, as for the TFE resins, is so high that it is above the measurable range; and is higher than for any other solid insulation over the full temperature range to 400°F. (Figure 2).

FIGURE 2

INSULATION RESISTANCE
(OHMS/1000 FEET)

| | Before Aging | After 500 hrs. at 300°F | After 96 hrs. 500°F. |
|---|---|---|---|
| "Teflon" TFE resins | $>2.5 \times 10^{13}$ | $>2.5 \times 10^{13}$ | $>2.5 \times 10^{13}$ (4000 hrs. to date) |
| "Teflon" FEP resins | $>2.5 \times 10^{13}$ | $>2.5 \times 10^{13}$ | $>2.5 \times 10^{13}$ |

**Aging** at either 400°F or 500°F had no effect on the insulation resistance of the FEP resin; however, it is not necessary to go this high in temperature to show the superior resistance to aging of the "Teflon" fluorocarbon resins. Of 7 basic different types of high grade wire insulation tested, after aging at 300°F. for 500 hours, **only** the "Teflon" FEP and TFE resins maintained insulation resistance above 25,000 ohms per thousand feet; these "Teflon" resins in fact showed no change from their initial values of over 25 MM megohms per thousand feet (or a factor of 1 billion better than the other materials tested). Even at 200°F., gradual thermal degradation of the other insulations tested could be detected at 250 hours, based on multiple tests at room temperature of randomly selected 50 ft. samples of commercial wire with a nominal 10 mil wall insulation. Volume resistivity ($10^{18}$ ohms centimeters) and surface resistivity ($10^{16}$ ohms per square) were also at the top of the measurable range (Figure 3) for both the FEP and TFE-fluorocarbon resins, and (consistent with the insulation resistance) higher than for any of the other materials tested. The surface and volume

FIGURE 3

SURFACE RESISTIVITY AND VOLUME RESISTIVITY OF "TEFLON" FLUOROCARBON RESINS VS. TEMPERATURE

| Resins | Volume Resistivity | Surface Resistivity | Measured Temp. Range* |
|---|---|---|---|
| TFE resins | $>10^{18}$ ohm-cm | $>10^{16}$ ohms/sq. | -40°F to 440°F. |
| FEP resins | $>10^{18}$ ohm-cm | $>10^{16}$ ohms/sq. | -40°F to 440°F |

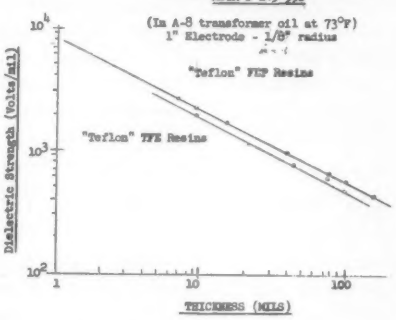
*Limits of measuring equipment

resistivities of the "Teflon" resins were not affected by heat aging or by temperature. The reliability offered by both the "Teflon" resins even at normal operating temperatures is an advantage that has not been fully appreciated heretofore.

★ ★ ★

**(Dielectric Strength)** — The dielectric strength of the FEP-fluorocarbon resin is high, regardless of whether measured on wire or sheet, or with respect to thickness, temperature, or thermal aging. Initial dielectric strength by the standard ASTM short-term test is very high (Figure 4). As with any material

FIGURE 4
DIELECTRIC STRENGTH SHORT TIME TEST
ASTM D 149-55T

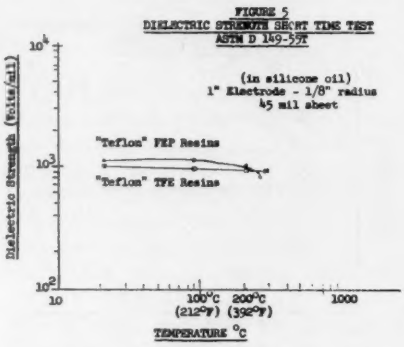



the value drops for increasing thicknesses but for the FEP resin is high even in thick sections.

★ ★ ★

**When** measured relative to temperature, tests on wire insulation in air and on sheet material in silicone oil showed that the initial dielectric strength of the FEP-fluorocarbon resin was above that for all other high temperature resins and elastomers from 72°F - 400°F. (Figure 5). At temperatures above 450°F, however, the

FIGURE 5
DIELECTRIC STRENGTH SHORT TIME TEST
ASTM D 149-55T

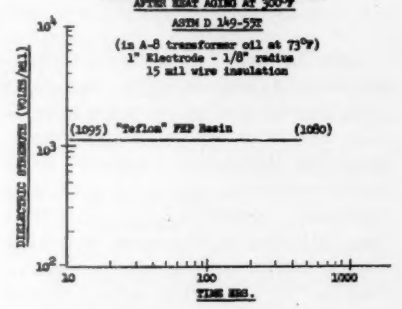



TFE-fluorocarbon resins have even better dielectric strength than the FEP resin and the other flexible insulating materials tested.

★ ★ ★

**Short-term** tests on 15-mil insulation on wire after exposure to 300°F air for 500 hours showed that the breakdown strength of the FEP-fluorocarbon resin was also well above that of the other standard high temperature insulations after heat aging (Figure 6).

FIGURE 6
DIELECTRIC STRENGTH SHORT TIME TEST
AFTER HEAT AGING AT 300°F
ASTM D 149-55T




**(Dielectric Constant and Dissipation Factor)**—Both the dielectric constant and dissipation factor for the FEP-fluorocarbon resin appeared to be very similar to those for the TFE-fluorocarbon resins from —40° to at least 400°F. The dielectric constant (Figure 7) is flat over the frequency range from below 100 cps to above 3000 Mc. and, like the TFE resins, very low, (2.1). Similarly the dissipation factor (Figure 8) is very low over the same wide temperature and frequency range. The combination of these two properties makes the FEP resin, like the TFE resins, a very nearly ideal insulator for radio and radar frequencies, as well as for normal power frequencies, since both low power losses and low

FIGURE 7

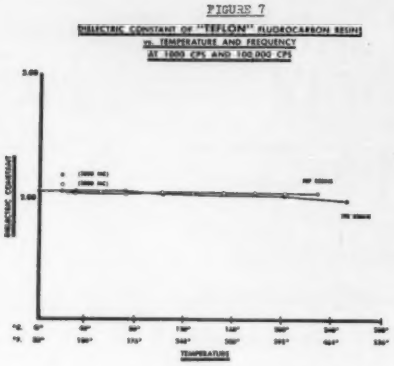
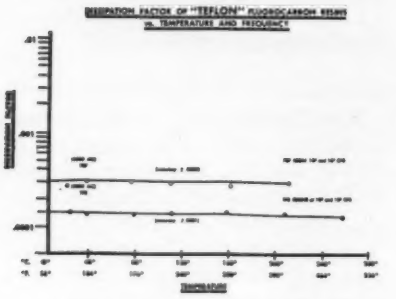


FIGURE 8



capacitive effects are inherent in these materials.

★ ★ ★

**(Mechanical Properties — Abrasion Resistance)**—By the standard tape abrasion test on wire insulation, the FEP resin at room temperature performs better than other materials such as polyvinyl chloride, polychlorotrifluoroethylene, silicone rubber and the TFE resins before heat aging but not as well as "Zytel" nylon resin (Figure 9). After heat aging 96 hours at 300°F. the FEP resin was superior to all materials tested.

FIGURE 9

ABRASION RESISTANCE OF WIRE INSULATIONS

MIL-T 5438 ABRASION TESTER

ALUMINUM OXIDE, 400 GRIT, 10 AND 15 MIL WALL INSULATION

| | TAPE TRAVEL IN INCHES | | | | |
|---|---|---|---|---|---|
| 15 mil wall, 1.0 lb. test weight | <50" | 50-74" | 75-99" | 100-124" | >125" |
| 10 mil wall, 0.5 lb. test weight | <25" | 25-49" | 50-74" | 75-99" | >100" |
| RATING | POOR | FAIR | GOOD | GOOD-EXC. | EXCELLENT |

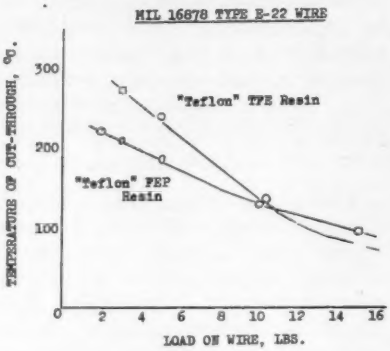
| Insulation | Before Aging | After 96 hrs. at 300°F | After 96 hrs. at 400°F |
|---|---|---|---|
| nylon | Excellent | good | |
| FEP-fluorocarbon | good-excellent | good | good |
| TFE-fluorocarbon | good | fair-good | good |

**(Cut-through Resistance)** — At room temperature, wire insulated with FEP-fluorocarbon resin has mechanical cut-through resistance at least equal to that of good 105°C. polyvinyl chloride. Between 100°C and 150°C (Figure 10), the "Teflon" FEP and TFE resins are about equivalent in cut-through resistance, and they are better than all other thermoplastic materials. At above 150°C the TFE resin is superior to the FEP resin in cut-through resistance on wire.

TABLE 10

TEMPERATURE OF CUT-THROUGH VS. LOAD

MIL 16878 TYPE E-22 WIRE




A summary of some of the other mechanical characteristics of the "Teflon" FEP-fluorocarbon resin is tabulated. (Figure 11). Note that the FEP resin passed the standard military reverse mandrel bend cold bend test at —85°F. followed by the dielectric strength at room temperature; no change in properties was observed.

★ ★ ★

**(Chemical Resistance)** — The chemical resistance of the "Teflon" FEP-fluorocarbon resin, like the TFE resins, is outstanding (Figure 12); no significant changes in tensile strength or elongation were observed for "Teflon" FEP film samples exposed respectively to 'Skydrol' hydraulic fluid, hydrochloric acid and sulfuric acid for 120 hours at 400°F. On 10-mil samples of the FEP resin exposed in the military specification tests for 20 hours respectively to transformer oil, 'Skydrol' hydraulic fluid, aircraft oil, aviation gasoline, turbine oil and turbine fuel, salt water, naphtha, and isopropyl alcohol, the dielectric strength showed no drop and remained above 1,230 volts per mil in all cases. (The TFE resins were likewise unaffected). The significance of these results cannot be minimized. Other plastics and elastomers were seriously degraded, either by hydraulic fluids like 'Skydrol', fuels such as aircraft gasoline, or solvents such as isopropyl alcohol. Where reliability in the presence

FIGURE 11

MECHANICAL PROPERTIES

| | "Teflon" fluorocarbon resins | |
|---|---|---|
| **Coefficient of Friction** | FEP | TFE |
| Inclined Plane - against steel, 77°F | 0.09 | 0.025 |
| **Tensile Strength** | | |
| (Typical values, psi) | | |
| -321°F | 16,000 | 16,000 |
| 73°F | 3,080 | 3,100 |
| 392°F | 850 | 1,050 |
| **Elongation** | | |
| (Typical values, %) | | |
| -321°F | 4-5% | 5-10% |
| 73°F | 250-350% | 470-570% |
| 392°F | 200-250% | 400-450% |
| **Flexural Modulus** | | |
| (Typical values, psi) | | |
| 73°F | 52,000-60,000 | 80,000-85,000 |
| 392°F | 6,000-8,000 | 10,000 |
| **Cold Mandrel Bend** | | |
| MIL-W-16878B (-85°F) | passes | passes |

FIGURE 12

RESISTANCE OF "TEFLON" FEP-FLUOROCARBON RESIN TO CHEMICAL ATTACK

| One Week Exposure of Film at 212°F | Tensile Strength, Elongation |
|---|---|
| 'Skydrol' Hydraulic Fluid | Unchanged |
| Benzene | Unchanged |
| Carbon Tetrachloride | Unchanged |
| Ethanol | Unchanged |
| 20% Hydrochloric Acid | Unchanged |
| 50% Sodium Hydroxide | Unchanged |
| Red Fuming Nitric Acid | Unchanged |
| **120-Hour Exposure of Film at 400°F** | |
| 'Skydrol' Hydraulic Fluid | Unchanged |
| 20% Hydrochloric Acid | Unchanged |
| 50% Sulfuric Acid | Unchanged |
| **20-Hour Exposure of Wire Insulation (10-mil) at 73°F *** | **Dielectric Strength** |
| A-8 Transformer Oil | Unchanged |
| 'Skydrol' Hydraulic Fluid | Unchanged |
| Hydraulic Oil-A (Aircraft Oil) | Unchanged |
| 80 Octane Aviation Gasoline | Unchanged |
| 'Univis' J-43 Turbine Oil | Unchanged |
| JP-4 Turbine Fuel | Unchanged |
| Salt Water | Unchanged |
| Naphtha | Unchanged |
| Isopropyl Alcohol | Unchanged |

* Standard Test MAS-703

of solvents and chemicals is valued, the perfluorocarbon resins are unexcelled.

## Processing

In the processing of FEP resin onto wire, a conventional extruder is used. The normal processing temperatures are 650°F to 740°F; therefore, the extruder should be electrically heated and capable of operating up to 800°F. Each zone of the extruder should have its own temperature controller. A stock thermocouple should be used to determine the true melt temperature.

★ ★ ★

We recommend a metering type screw with a constant pitch and a sudden compression in the ratio of 3 to 1. The barrel length to diameter ratio should be at least 18/1 although shorter barrels have been used satisfactorily. The larger length to diameter ratio assures complete melting and better temperature uniformity.

★ ★ ★

Normally a breaker plate is used to insure complete melting of the resin. Although no difficulty is experienced in operating with screen packs, they are seldom necessary or advantageous.

★ ★ ★

FEP resin, being an halogenated resin, we might expect in long-term running that corrosion would be a problem. However, we have experienced negligible corrosion in terms of dimensional change. Improper selection of construction materials can result though in product contamination problems due to trace amounts of corrosion products. Difficulties with corrosion and product contamination are most likely to occur when extruder temperatures are allowed to exceed the recommended operating range or during burn-out. One of the best safeguards against corrosion and product contamination is proper temperature control. The use of a purge resin in terminating a run is also desirable in that it reduces the possibility of corrosion, the safety hazards, and the time needed for cleanup. One such purge resin consists of a mixture of one part polyethylene, and four parts barium sulfate.

★ ★ ★

The materials of construction recommended to give adequate corrosion resistance are a barrel liner of "Xalloy" 306, a screw of Type 410 stainless steel and die, breaker plate, and head parts of Type 410 or Type 416 stainless steel.

★ ★ ★

"Teflon" 100X FEP resin, in the melt state, has excellent draw properties. In processing onto wire, this property is used to advantage by employing a tubing type extrusion. Drawdowns of well over 100/1 have been used successfully.

★ ★ ★

For design purposes we use a guider tip diameter which is ten times the diameter of the wire or primary and a die diameter of ten times the diameter of the finished construction.

★ ★ ★

We have found in an evaluation program on pigmented compositions of FEP resin that commercially available pigments which are thermally stable are very satisfactory and can be incorporated in the resin easily. The pigments should be of a fine particle size and should receive a precautionary drying before incorporation. Dry blending in which the cubes are tumbled with the required percentage of pigment prior to extrusion is the simplest method and gives a very satisfactory product. Pigment concentrations of less than one per cent are normally used.

★ ★ ★

Applications — FEP resin has been made into a number of wire and cable constructions. It has been used as a primary insulation in hook-up wire, magnet wire, harness wire, and in miniature coaxial cable cores. FEP resin has been applied to silver-plated copper, aluminum-plated copper, tinned copper, and bare copper conductors successfully. The conductors have ranged in size from AWG #30 to AWG #14 and have been of both solid and stranded varieties. To date, we have been able to obtain primary insulations as thin as 4 mils and as thick as 45 mils successfully. We have demonstrated rates as high as 600 fpm on standard hook-up wire constructions.

★ ★ ★

FEP resin is considered an excellent jacketing material. We have successfully jacketed a number of shielded and unshielded constructions. The primaries in these constructions have been insulated with a variety of resins including "Teflon" TFE resin, silicone rubber, vinyl, polyethylene, and FEP resin. No difficulty has been experienced in jacketing over glass or silver braids or over multiconductor cables. Jackets as thin as 3 mils and as thick as 15 mils have been applied.

★ ★ ★

We expect usage of the various constructions primarily in the aircraft and missile industries where each of the properties in which the FEP resin excels are necessary for satisfactory performance.

★ ★ ★

Figure 13 shows that FEP resin meets the rigorous requirements for insulation properties needed in aircraft and missiles with a margin for additional reliability.

FIGURE 13

INSULATION PROPERTIES NEEDED IN AIRCRAFT AND MISSILES

| | Properties of FEP Resin |
|---|---|
| High service temperature | 200°C |
| Low water absorption | 0 |
| Resistance to - | |
| Red fuming nitric acid | no effect |
| Liquid oxygen | " |
| "Skydrol" hydraulic fluid and other lubricants | " |
| Aircraft fuels | " |
| Solvents | " |
| Flexible at -65°C | flexible at -90°C |
| High dielectric strength | excellent |
| Abrasion resistance | excellent |
| High insulation resistance | excellent |

In the electronics industry, the ability of FEP-fluorocarbon resin to be extruded over tinned copper permits the combination of conventional automatic cutting and soldering equipment with a high reliability, high temperature insulation.

★ ★ ★

Other anticipated uses for wire

(*Please turn to page* 1283)

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# Polyethylene for Overhead Line Wire

by F. W. Wurtzell
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**Polyethylene**, second largest and fastest growing of all plastic materials, can attribute much of its present success to the wire and cable industry. Prior to 1946, most of the polyethylene commercially available was used as insulation for military communications applications such as high-frequency radar installations, submarine cable and telephone cables which were utilized in D-Day landings in Normandy. 1944, the first full year of commercial production, saw a total of 15 million pounds of polyethylene manufactured in this country. It is estimated that the manufacture of polyethylene totalled 630 million pounds in 1957, with 70 million pounds consumed by the wire and cable industry.*

★ ★ ★

**The** properties and characteristics of polyethylene were soon recognized by wire manufacturers as being particularly well-suited for use as a covering for line wire where extended outdoor exposure is required. Line wire, in occupying an intermediate position between insulated and bare wire, is not insulated for the full voltage it carries but relies principally on its supporting insulators. Therefore, the polyethylene is not employed as an insulation "per se" in this construction but as a protective covering. Just as polyethylene has grown by leaps and bounds in popularity, the amount of this material consumed by the line wire industry has enjoyed similar success. Except for communication cables, more polyethylene is now used for line wire than any other application in the wire and cable field.

★ ★ ★

**The** establishment of standards by both the American Standards Association and the Insulated Power Cable Engineers Association has accompanied the growth of polyethylene in wire applications such as line wire. In working closely with manufacturers, consumers and technical agencies, these organizations have established test methods and specifications which will assure the most desirable polyethylene materials for weather-resistant wire. Table 1 compares some of the requirements established by the ASA and IPCEA with the properties of BAKELITE polyethylene compound, DFD-4401, principally designed for use in line wire.

★ ★ ★

* Estimates, Modern Plastics, January, 1958.

F. W. Wurtzell

**The author graduated from the University of Illinois in 1942 with a B.S. degree in Chemical Engineering. He was employed by the Bakelite Company in 1942 as a Research and Development Engineer on wire and cable insulations. In 1946 he was transferred to the Sales Department as a Technical Representative and has served in that capacity until 1957 when he was made Central Zone Manager of the Extrusion Materials Division. Mr. Wurtzell is also a member of the A.C.S., A.I.E.E., S.P.E., and The Wire Association.**

**This paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City, N. J., on October 15, 1958.**

TABLE 1

| | ASA | IPCEA | DFD-4401 |
|---|---|---|---|
| Specific Gravity | 0.91 - 0.94 | — | 0.92 |
| Melt Index, gms/10 min. | 2.1 | — | 0.95 - 2.1 |
| Tensile Strength, psi | 1200 | 1400 | 1600 |
| Ultimate Elongation, per cent | 300 | 350 | 600 |

★ ★ ★

As is indicated by this table, polyethylene coverings not only meet but exceed the minimum requirements of both the ASA and IPCEA specifications.

★ ★ ★

**Polyethylene** covered line wire chiefly competes with polychloroprene and with triple-braid URC asphalt saturated "weather-proof" wire. Vinyls have only briefly entered this field of application in the wire and cable industry. While polyethylenes of the low density variety have been employed almost exclusively on line wire, high density polyethylenes are filling a need as coverings for tree wire. These high density resins have greater rigidity, better deformation and abrasion resistance, higher tensile strength, improved heat resistance, and somewhat lower permeability than lower density resins.

★ ★ ★

**In** 1939, a pioneer in the wire and cable field presented before the American Chemical Society those characteristics which he thought most desirable in a plastic insulation or covering material. A few years ago, that same person, speaking before a group of wire experts, proclaimed that polyethylene, while still lacking in some areas such as softening point, comes closest to fulfilling those ideal characteristics. Polyethylene possesses a balance of properties which makes it

ideally suited for the complicated set of adverse conditions to which weather-proof line wire coverings are subjected. It will be of interest to review briefly some of the important properties of a polyethylene, Bakelite DFD-4401, and to compare this material with other currently used coverings.

## Light Weight

**One** of the outstanding properties of polyethylene which promote its use in line wire is the material's light weight. The specific gravity of DFD-4401 at .920 makes possible a lighter weight wire. This advantage is of interest in reducing the span load or increasing the distance between poles. The light weight of polyethylene contributes to easier and less costly handling, installation, and maintenance. Polyethylene's light weight combined with the low temperature impact resistance of the material indicate an outstanding fatigue resistance to wind-whipping at low temperatures. Table 2 compares weights for the three most frequently used materials for line wire. A 30 to 50 per cent weight saving can be realized by installers when utilizing polyethylene coverings.

TABLE 2
Weight of Covering
(pounds per 1000 ft. of wire)*

| AWG or MCM | Neoprene | Polyethylene | Triple Braid Weather Resistant |
|---|---|---|---|
| 6 | 21.5 | 7.5 | 32.5 |
| 4 | 25.6 | 9.6 | 37.6 |
| 2 | 43.1 | 25.1 | 65.1 |
| 1/0 | 72.2 | 41.2 | 98.2 |
| 4/0 | 107.7 | 61.7 | 146.7 |
| 350 | 159.0 | 76.0 | 264 |
| 500 | 215.0 | 104.0 | 350 |
| 750 | 298.0 | 171.0 | 506 |

* American Standard Association

## Low Temperature Brittleness

**Possessing** excellent low temperature characteristics, polyethylene has exhibited remarkable performance in service even under severe weather conditions. The low temperature impact resistance rating — the brittle temperature under sharp impact—for DFD-4401 Black 9845 ranges as low as —55 deg. C. to —95 deg. Centigrade. This excellent performance is partly a result of the exceedingly low change in stiffness with changes in temperature.

★ ★ ★

**The** brittleness of elastomers, rubber and polyethylene is often measured by means of a brittleness impact test (Figure 1). In this test the specimens, after being preconditioned at temperatures considerably below room temperature, are struck by an arm attached to a revolving flywheel. The ideal curve for such a test would be a horizontal line. Figure 1 shows a sharp transition for the plasticized vinyl compounds, gum rubber and unfilled polychloroprene. With polyethylene, however, an unusual phenomenon is observed. Here the transition from a flexible to a relatively rigid material is very broad. The elastomeric qualities begin to be lost at about —55 deg. C but are not completely lost until about —95 deg. Centigrade. High density polyethylenes such as BAKELITE DGDB-4100 Black 9845 exhibit even better low temperature brittleness properties. For these materials to reach 20 per cent failure, temperatures must be around —105 deg. Centigrade.

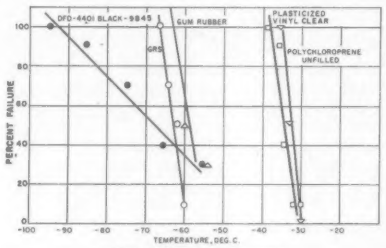

FIGURE 1. BRITTLENESS TEMPERATURE

## Weathering

**The** weathering properties of polyethylene are similar to those of rubber in that the unpigmented polymer on outdoor exposure will craze, crack, and become degraded in properties. The loss in flexibility and degradation of low temperature impact resistance of polyethylene is due primarily to oxidation induced by the ultra-violet energy present in sunlight. Therefore, pigmentation is necessary and, as in rubber, the incorporation of carbon black prolongs the weathering life appreciably. Carbon black is a suitable pigment because of its fineness and opacity, both properties contributing to the high degree of light screening obtained even in low concentrations. The resistance to aging of any given polyethylene-carbon black compound depends on the following three factors: the type and particle size of the carbon black; the concentration of the carbon black; and the dispersion of the carbon black in the polyethylene.

★ ★ ★

**The** dependence of aging on carbon black concentration is illustrated in Figure 2. Aging resistance is shown to increase with carbon black concentration until a loading of 2 to 5 per cent is reached. Normally, a concentration of 2½ per cent is employed with polyethylene.

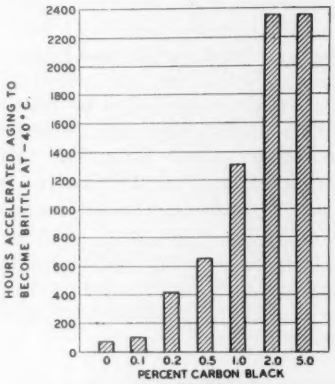

FIGURE 2
EFFECT OF CARBON BLACK CONCENTRATION ON ACCELERATED AGING OF POLYETHYLENE

A line wire covering of DE-6411 Brown, a predecessor to DFD-4401, was recently removed for testing after seven years' service in a Midwest city. The covering still provided faithful service at the time of removal. Physical property data, as indicated in Table 3, compare the original properties with those determined on the wire covering after seven years' service. These data serve to illustrate that even brown polyethylene can provide satisfactory performance for many years. A black compound with its even better weathering properties can be expected to give a service life measured in decades.

## Abrasion Resistance

**An** outstanding property of polyethylene coverings is their excel-

TABLE 3

Effect of Aging on Polyethylene Covered Line Wire*

| Typical Property | BAKELITE DE-6411 Brown Original | After 7 Years' Service |
|---|---|---|
| Tensile Strength, psi | 1400 | 1100 - 1600 |
| Ultimate Elongation, per cent | 400 | 95 - 115 |
| Melt Index, decigms./min. | 1.70 | 1.0 - 2.4 |
| Brittle Temperature, deg. C. | <-45 | -60 |
| Carbonyl (Infra Red), per cent | 0 | .045 |

* 2/64" covering on AWG #4 Solid Copper Conductor.

lent resistance to abrasion. In a series of tests, polyethylene and polychloroprene samples were abraded with "Alozite" Metal Cloth No. 320, cold-rolled steel and maple wood under conditions of rotary motion, reciprocating motion and a combination of both. In every case, the results with polyethylene were superior to those obtained with polychloroprene.

## Size and Surface Smoothness

**The** outstanding handling qualities and appearance of polyethylene have made it a favorite material with installation crews and users of line wire and other weather-proof coverings. The installation of line wire covered with polyethylene is faster, easier, and the cost and maintenance are considerably reduced.

★ ★ ★

**The** physical properties of polyethylene make feasible the use of a thinner wire covering than is usually applied in the case of other coverings such as triple braid or polychloroprene. The reduced diameter plus the smooth, wax-like surface characteristics of polyethylene reduce the effective wind load, as well as ice load, on line wire. This increases the actual fatigue life of the line still further by reducing the effective forces at play. Utility users stress that the smaller outside diameter permits greater footage on the reel; trucks can transport more feet of wire at one time, thus making less trips to supply depots. The smaller wire size is neater looking on three conductor drop wire. The neat appearance of service drops has gained more importance with the trend towards ranch-type homes where the wire is closer to the ground.

**Installation** is made unusually simple due to the reduced diameter and the smooth surface of polyethylene-covered line wire. Polyethylene coverings hug the wire tightly and yet are easily stripped even after years of storage or service and leave a clean bare wire. Coverings of polyethylene resist bunching and tearing when being pulled over crossarms. Polyethylene is clean to handle when compared to other covering materials.

## Electrical Properties

**While** not part of the stringent requirements specified for line wire coverings, the electrical properties of polyethylene contribute to the uninterrupted service of the wire. The resistance of polyethylene coverings to dielectric failure depends largely on the dielectrics of the material. As a flexible material, polyethylene possesses outstanding electrical properties. It has a high AC and DC resistivity, a high dielectric strength, a low dielectric constant, and a low power factor. These exceptional electricals reduce outages due to casual and accidental grounding as a result of contact with trees, branches or foreign objects across the lines. One railroad has completely changed from bare to polyethylene-covered wire, thus eliminating mischievous and casual groundings.

## Resistance to Chemicals and Moisture

**Polyethylene** resists attack by most chemicals, is a strong barrier to water, and is virtually non-absorbent. These characteristics are necessary if the covering is to preserve the integrity of the physical and electrical properties of the material. After two years immersion in water, the tensile strength, elongation, compression and tear strength of polyethylene showed very little change; nor did the electrical properties evidence any marked alteration.

## Fabrication

**From** the standpoint of the wire manufacturer, polyethylene can be applied more easily and economically than either polychloroprene or triple-braid URC asphalt saturated coverings. In the case of polyethylene coverings, the necessary equipment is relatively simple — an extruder, cooling trough and winding apparatus. Polychloroprene compounds must be processed in a Banbury and milled before being fed into an extruder and then vulcanized. Triple-braid coverings must be processed through braiding or knitting, saturating and finishing equipment.

## Conclusion

**From** the preceding discussion it can be concluded that polyethylene stands up very well both in physical and electrical properties and can be depended upon to give many years of fault-free service. Because it is lighter than other types of coatings, it handles easier during installation. Despite its free stripping characteristics, polyethylene has excellent adhesion to the conductor and will not ruffle over the crossarms. Its smooth and slippery surface makes pulling easier and a cleaner wire with which to work. Since polyethylene forms a continuous permanent abrasion resistant coating over line wire, fewer outages result from contact with other objects. With its smaller diameter, polyethylene covered line wire offers advantages during wind and ice storms.

★ ★ ★

**The** past performance of this wire in the field together with its almost ideal property balance indicates that the field of secondary power distribution will continue to use an expanding footage of polyethylene line wire.

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(*Please turn to page* 1275)

# Some Recent Applications of High Density Polyethylene

by B. H. Krevsky
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## Introduction

**Polyethylene** and wire have been working side-by-side in this country for approximately fourteen years. Proof of the success of this combination in wire and cable applications is the 70 million pounds of polyethylene consumed in 1957 for such purposes. Only a product with good working properties could account for sales figures of such magnitude—and polyethylene does possess the most outstanding properties of any flexible dielectric material — low power factor and dielectric constant, high A.C. and D.C. resistivity, and high dielectric strength.

★ ★ ★

**The** polyethylenes which achieved such success actually belong to one class of polymers which has been varied to a slight degree in crystallinity and molecular weight to obtain desired properties. It was only natural that the quest for property variation should turn in the direction of extensive polymer changes —and to make these changes many different manufacturing processes and techniques have been developed. The most publicized method of attack was the use of relatively low processing pressures to produce more crystalline, linear polyethylenes. However, similar linear, slightly branched polymers have also been made by the older high-pressure techniques. The resultant products, all designated as high-density polyethylenes, possess properties which are viewed as being complementary to those of low-density or standard polyethylenes.

★ ★ ★

**While** retaining such general attributes of standard polyethylene as low-loss electrical properties, excellent chemical and mechanical properties, moisture resistance and easy extrusion on wire and cable, high-density polyethylene also exhibits greater rigidity, good impact and abrasion resistance, good high-temperature performance, improved stress corrosion cracking, higher tensile strength, and somewhat lower permeability. The first three properties are of particular importance for wire and cable. The higher deformation temperature of the high-density polymer is a secondary advantage which should only be considered as a safety factor and not as a means for raising the overall operating temperature.

B. H. Krevsky

**Mr. Krevsky was graduated from Rutgers University in June 1944 with a B.S. in Chemistry degree. Following service in the U.S. Navy, he received a M.S. degree in Physical Chemistry at Polytechnic Institute of Brooklyn in June 1947. Following employment with two major oil companies and an operations research consulting firm, he joined Bakelite in 1954, where he worked in the Development Laboratories of Bakelite on molding and extrusion materials. At present, he is attached to the New Product Engineering Department. His function is the development and promotion of new extrusion materials for wire and cable products.**

**This paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City on October 14, 1958.**

## Applications

**Because** of the unique properties of the high-density polymers, previously closed markets are now open to polyethylene. These very same properties, however, may also be barriers to the utilization of this material in some current applications. In thin-walled insulations, for example, the rigidity and strength of high-density polyethylene will be of particular value, but in large cable applications where a thick-walled jacket is required, the added rigidity of the insulation may be a limiting factor.

★ ★ ★

**Tree** wire and service drop cable are two prime examples of applications which can benefit from the use of high-density polyethylene. In both cases, the wire covering must be weather resistant and tough. In many installations, both tree wire and service drop cable are badly abused by moving limbs. The coverings usually employed for such wire include standard polyethylene plus nylon or comparatively expensive textile-over-rubber combinations. When high-density polyethylene was used in field tests as tree wire, the results were even better than expected. Not only was the wire not affected by tree limbs, but it actually wore down sections of the limb. The wire used ranged in size from number 4 to 300,000 circular mils, and wall thicknesses measured 3/64-, 5/64-, and 10/64-inch thick. High-density polyethylene is similarly valuable for insulation on service drop cable, where abrasion resistance is a

must. Also, lifetime expectations for constructions made with linear polyethylenes are high—presently, wire and cable utilizing the first Bakelite high-density compound, DGD-4100, have been in service on test installations for over one year with completely satisfactory performance.

★ ★ ★

**Abrasion** resistance, rigidity and toughness are also important factors in relation to many other wire applications. In one recent application, high-density polyethylene was used as insulation on magnet wire for submersible pumps. Magnet wire is usually dip-coated in enamel and then baked. But by using this tough thermoplastic insulation, protection was afforded against hammering during installation and against surface cracks which could short under water afterwards. For this application, a high-density compound similar to Bakelite high-density polyethylene, DGD-4100, was extruded as an 8-mil wall on a number 26 wire. The extruded insulation provided an economical, tough, and abrasion resistant coating perfectly suited for underwater exposure.

★ ★ ★

**A** second application, a military field wire, further points up the confidence placed in the performance of high-density materials. Since failure of military communication wire might mean death or disaster, materials of outstanding quality must be used. The design of wire for such purposes is constantly changing as new concepts of military warfare are developed. One particular new design for a grid network of field communication required the use of a coaxial-type communication cable which could be laid in the field by a helicopter. In this application the linear polyethylene, with its excellent abrasion resistance, can withstand shocks caused by boulders, rocks, trees, or moving military vehicles. A twisted coaxial cable pair was designed using high-density polyethylene for both insulation and jacketing. On subsequent testing, the additional rigidity of the insulation was found to be unnecessary, since the jacketing alone provided the desired degree of toughness and abrasion resistance.

★ ★ ★

**High-density** polyethylene is also under evaluation as a bridle wire, used to connect single communication wires on telegraph poles where the primary requirement is for a tough, abrasion resistant material. On the basis of the tree wire tests, we can expect that bridle wire produced from this material will be almost as durable as the telephone poles themselves.

★ ★ ★

**In** telephone communication applications, an evaluation of linear polymers has shown greatly improved toughness and crushing resistance during cabling into exchange area cables.

★ ★ ★

**The** requirement for rigidity is not limited to the foregoing applications, which are only a few examples selected from many. In the same way, the following illustrations are but a small sampling of the many applications now open to high-density polyethylene by virtue of its high-temperature properties.

★ ★ ★

**In** a special coaxial cable for television hook-up applications which is subjected to intermittent high temperatures of about 120 deg. C., standard polyethylene could not be used. However, when this cable was made with Bakelite high-density polyethylene, DGD-4100, it withstood at least 168 hours at 118 deg. C. in heat shock tests, and has been used successfully in the final commercial installations.

★ ★ ★

**In** another coaxial-type cable used for missile-control, high-density polyethylene not only protects the conductor against intermittent high temperatures, but also serves as a structural component. The special design of this cable consists of a central, spiraling fin, whose position is maintained by the rigidity of the polyethylene insulator. The air spaces thus formed on each side provide additional insulation, and thereby help minimize inductance effects.

★ ★ ★

**Although** very few power cable applications presently use high-density polyethylene, there is every indication that this material should perform as well as standard polyethylene in conventional applications — and also give an added heat-deformation safety factor of 20 to 30 deg. Centigrade. In support of this belief, Bakelite Company is planning to use high-density polyethylene for insulation in the 5 KVA cable of the main power supply at its Whiting, Indiana, plant.

★ ★ ★

**High-density** linear polyethylene also possesses another characteristic which should prove increasingly useful in the next several decades. This material, of all the insulation materials now available for wire and cable applications, is least affected by gamma radiation. The value of such relative immunity in a nuclear and space age is obvious; and evaluations are presently being conducted on the use of linear polyethylene for satellite hook-up wire, nuclear reactor control cables, and other wires and cables used with reactors or in other areas of high gamma ray intensity.

## Properties of High- and Low-Density Polyethylene

**Polyethylene** polymers are generally both crystalline and amorphous in nature. The fact that most of the polymers combine these two components makes them particularly useful for wire and cable applications. A totally amorphous material would be soft and waxlike and would have limited use as an insulating material. A totally crystalline polymer would have brittle and glasslike characteristics and would also be of limited value. The presence of the two components in polyethylene and the ratio in which the components occur determines to a large extent the final properties.

★ ★ ★

**In** the following set of tables, a comparison is made of the properties of a typical Bakelite low- density electrical insulating compound (DFD-2005), a conventional high-density polyethylene (DGD-4100), and the newest Bakelite high-

density polyethylene compound (DGDA-5100).

★ ★ ★

As can be seen in Table I, a typical Bakelite low-density polyethylene resin for wire insulation has a density of 0.92 which corresponds to a crystalline content of about seventy per cent. An increase in crystallinity to approximately eighty-five per cent will give a density of about 0.95, or the density value for typical high-density materials.

TABLE 1

Physical Properties of Bakelite Extrusion Compounds

| Property | Conventional Low-Density Polyethylene DFD-2005 | Conventional High-Density Polyethylene DGD-4100 | New High-Density Polyethylene DGDA-5100 |
|---|---|---|---|
| Specific Gravity, 23/23°C. | 0.92 | 0.95 | 0.95 |
| Melt Index, gm/10 min. | 1.5 | 0.3 | 0.5 |
| Crystallinity, % | 70 | 85 | 85 |

★ ★ ★

The data also shows that the high-density polymers have melt indices of 0.3 and 0.5 as compared to 1.5 for the low-density material. Melt index is a good measure of relative molecular weights of polymers having the same given crystalline content or linearity and produced by the same process. However, when there are major differences in linearity, or if different manufacturing processes are used, a direct comparison of melt index measurements for estimation of relative molecular weights can be grossly misleading. This is due to the fact that the flow properties of linear and branched polyethylene polymers differ widely even when equal in molecular weight. At the temperatures at which the melt index test is run, 190 deg. C., the high-density polyethylenes are much less fluid, i.e., more viscous, than an equivalent molecular weight polymer with more highly branched molecules. Therefore, the melt index value is much lower.

★ ★ ★

Table II compares several mechanical properties of high- and low-density polyethylenes. The shear strength of the newest high-density compound is clearly superior to that of the low-density material, exceeding its value by 1000 psi, and is also approximately 10 per cent higher than that of conventional high-density polyethylene. This shear test is an excellent measure of cutting-type abrasion resistance, whereas the abrasion resistance test, indicated in Table II, measures the effect of strong rubbing against the material.

★ ★ ★

Again the data shows that the abrasion strength of high-density compounds is considerably higher than that of the low-density material. The values of compressive loading and durometer hardness similarly follow this general pattern. It is interesting to note that the brittleness index values are better for the more rigid, high-density materials despite their higher crystalline content. Tensile strength, too, is higher for the high-density polymers, being approximately twice that of standard polyethylene. At jaw separation speeds of one inch per minute, ultimate elongations (including cold drawing) about equal to that possible with the low-density polymers have been obtained. More often at high jaw separation speeds, values of 50 to 150 per cent are obtained. This decrease is believed to be due to the increased crystallinity and rigidity of the high-density polymers.

TABLE II

Mechanical Properties of Bakelite Extrusion Compounds

| Property | Conventional Low-Density Polyethylene DFD-2005 | Conventional High-Density Polyethylene DGD-4100 | New High-Density Polyethylene DGDA-5100 |
|---|---|---|---|
| Shear Strength, psi | 2300 | 2900 | 3300 |
| Abrasion Resistance, Strokes* | 11 | 46 | 58 |
| Compressive Loading, lbs./2 in. | 1500 | 2100 | 2100 |
| Durometer Hardness @ 23°C., "D" | 42 | 58 | 58 |
| Brittleness Index, °C., $F_{50}$ | −80 | −95 | −105 |
| Tensile Strength, psi | 1800 | 3400 | 3500 |
| Elongation, % | 600 | 50-150 | 50-150 |

* Longitudinal scraping at 90 degrees over metal bar with knife edge.

★ ★ ★

Table III summarizes stiffness in torsion measurements for both types of polymers. The high-density polymers have three to four times the stiffness of the low-density polymer at room temperature. Although the differences between these figures narrow at lower temperatures, at −50 deg. C. the high-density polymer still has approximately twenty-five per cent more stiffness. At the other end of the scale, the low-density type polymer cannot be measured at 90 deg. C. due to distortion, while the high-density polymer still has appreciable stiffness at 100 deg. C. (about 9000 psi).

★ ★ ★

Since the high-density polymers under discussion have been characterized by an increase in stiffness and toughness, some question may arise as to performance in environments conducive to stress cracking. However, a comparison of the stress corrosion cracking performance of linear materials and low-density polyethylene in Table IV indicates that the high-density polyethylene is superior in this regard. This relationship will hold for melt index values for both types of resins of about .3 or higher, but at lower values of melt index the high-density polyethylenes would probably be inferior in cracking performance. A complete explanation for this improved performance is lacking, but it is believed to be the effect of true molecular weight and molecular weight distribution differences.

★ ★ ★

In enumerating the properties of high-density polyethylene, mention was made of good high-temperature performance. Figure 1 gives a graphic illustration of the improvement in high-temperature-

TABLE III

Typical Stiffness Data of Bakelite Extrusion Compounds

| Temp., °C. | Conventional Low-Density Polyethylene DFD-2005 | High-Density Polyethylene DGD-4100 and DGDA-5100 |
|---|---|---|
| −50 | 230,000 | 310,000 |
| 23 | 24,000 | 100,000 |
| 90 | too soft | 14,000 |
| 100 | too soft | 9,000 |

TABLE IV

Stress Cracking Resistance of Bakelite Extrusion Compounds

| Condition | Conventional Low-Density Polyethylene DFD-2005 | High-Density Polyethylene DGD-4100 and DGDA-5100 |
|---|---|---|
| Aged 7 days @ 70°C., *$F_{50}$ .. | <0.2 | 48 hours |
| Annealed by boiling 30 min. in water, *$F_{50}$ ..... | 0.2 | 200 hours |

*$F_{50}$—Time to 50% failure of 20 specimens at 50° C. in "Igepal" CA Surfactant.

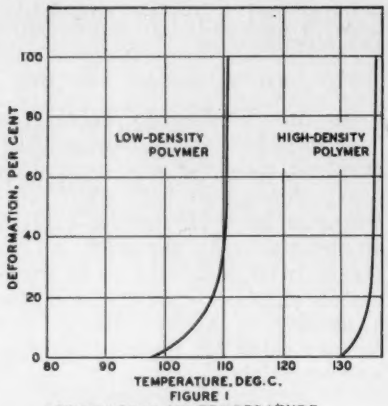


FIGURE 1

DEFORMATION VS. TEMPERATURE

(500 GM. LOAD)

deformation resistance which is obtained with the high-density polymer. While the low-density compound shows no deformation when the test is performed at 90 deg. C., there is a sharp increase in deformation between 100 and 110 deg. Centigrade. The high-density compounds give a similar performance curve, but at a level approximately 20 to 30 deg. C. higher.

★ ★ ★

**Any** discussion of the improvement of high temperature performance of polyethylene must include a consideration of the ability of the polymer to resist oxidation. Laboratory tests show that the high-density polymers resist oxidation to a greater degree than other polyethylene polymers. However, with all high-density polymers, oxidation resistance will still be a limiting factor on their high temperature, long-time performance, and the extra 20 to 30 deg. C. improvement in deformation temperature must be considered an added safety factor rather than an increase in the upper temperature limits for continuous operation. As with standard polymers, the oxidation resistance of all high-density polymers is such that an anti-oxidant is required. The nature of the anti-oxidant employed will influence, to some degree, the maximum operating temperature.

★ ★ ★

**Another** limitation to the use of high-density polyethylenes has been their tendency to embrittle and crack when subjected to elevated temperatures while under stress. This phenomenon is commonly known as "Thermal Embrittlement" and has been responsible for preventing the use of high-density polyethylenes in many applications where its improved toughness and better tensile properties are desired. The limitations in the use of high-density polyethylenes due to thermal embrittlement were not fully recognized until quite recently. Since the realization, much work has been done in an attempt to improve the property.

★ ★ ★

**Thermal** embrittlement is a function of resin melt index and density. For a given density, thermal embrittlement becomes more severe as the melt index increases. Likewise, for a given melt index, an increase in density correspondingly increases thermal embrittlement tendencies. Conventional high-density polyethylenes having very low melt index values (<0.01) display excellent thermal embrittlement resistance. However, these resins present manufacturing difficulties such as reduced processibility and extrudability with resultant higher compound and extrusion costs. DGDA-5100, the newest high-density extrusion compound, on the other hand, is a material possessing considerably greater resistance to thermal embrittlement than conventional high-density polyethylene.

★ ★ ★

**No** loss in processing characteristics is incurred to obtain a gain in thermal embrittlement resistance. Table V compares the thermal embrittlement properties of DGDA-5100 with conventional

(*Please turn to page* 1274)

TABLE V

Thermal Embrittlement Data of Bakelite Extrusion Compounds

| Property | Conventional Low-Density Polyethylene DFD-2005 | Conventional High-Density Polyethylene DGD-4100 | New High-Density Polyethylene DGDA-5100 |
|---|---|---|---|
| Specific Gravity, 23/23°C. ..... | .92 | .95 | .95 |
| Melt Index, gm/10 min. ..... | 1.5 | 0.3 | 0.5 |
| Insulation Embrittlement Hours to Fail in Air | | | |
| @ 70° C. ..... | 3400 | 3600 | 5200 |
| @ 113° C. ..... | softens | 48 | 168 |

TABLE VI

Electrical Properties of Bakelite Extrusion Compounds

| Property | Conventional Low-Density Polyethylene DFD-2005 | High-Density Polyethylene DGD-4100 and DGDA-5100 |
|---|---|---|
| Dissipation Factor, 50 mc .... | .0002 | .0002 |
| Dielectric Constant, 50 mc .. | 2.28 | 2.33 |

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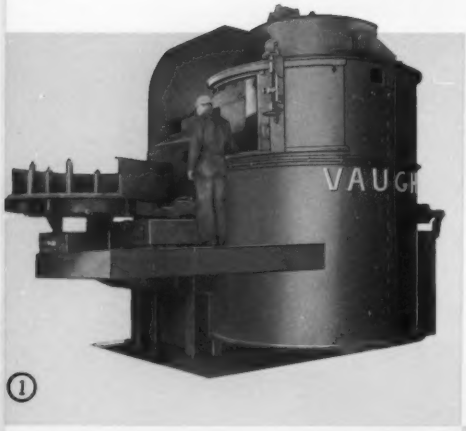

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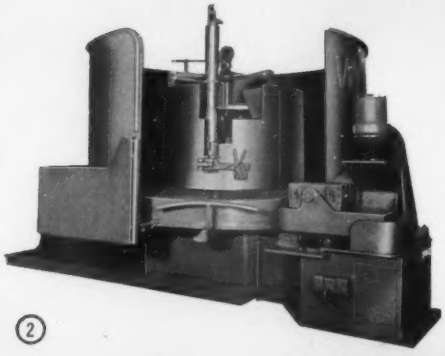
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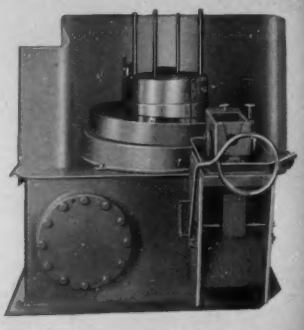
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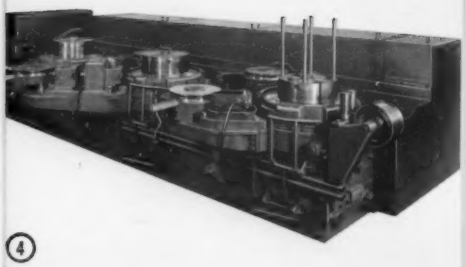
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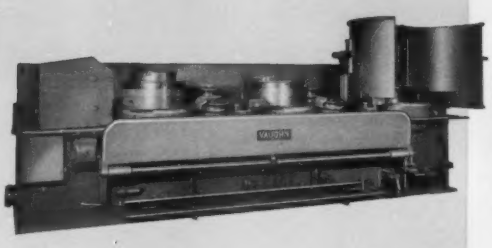

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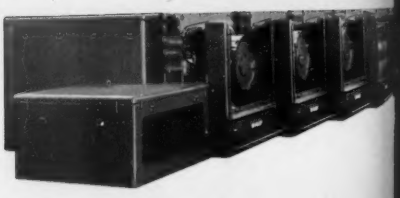
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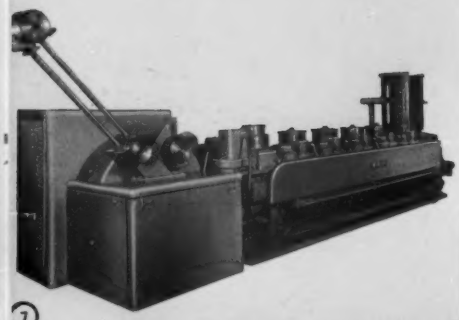
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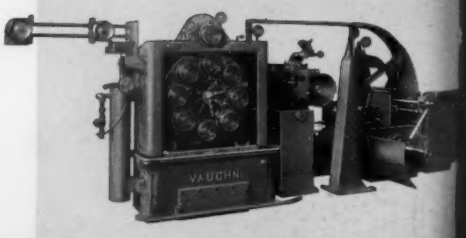

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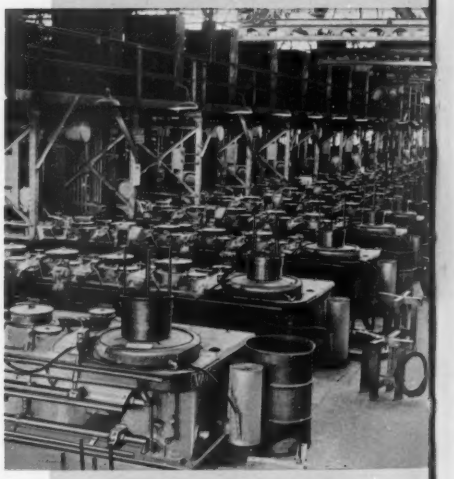

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# Pressure Lubrication of Wire Drawing Dies— A Practical Application

by Arthur V. Hedman
Die Room Foreman
Wickwire Spencer Steel Division
Colorado Fuel & Iron Corporation
Palmer, Massachusetts

At the time of the introduction of tungsten carbide dies to the wire industry and subsequent development of tandem or continuous wire drawing machines operating at greatly accelerated speeds, it became apparent that the elevated temperatures generated presented a very serious problem, not only in regards to die performance but the physical properties of the material being drawn were also involved, particularly high carbon steel wire.

★ ★ ★

Of primary importance at the time was the problem of arriving at a uniform reduction in area and to prevent distortion of the material in the drawing operation.

★ ★ ★

A variety of die blocks or die holders designed to dissipate most of the heat generated through the use of air or water as a cooling agent were tried and in 1933 a type of unique design was installed in our Palmer Plant.

★ ★ ★

**Figure 1** shows the various components of a water-cooled die holder designed to fit a standard 1½" die. #1 is the die block or die holder with the pipes attached for water connections. #2 is the wire drawing die. #3 is an interchangeable tungsten carbide guide plug having a bore with approximately the same profile as a drawing die except for the absence of any back-relief. This guide or "lubricating plug" is provided with a 6 degree back taper to match the bore in #4, a threaded bushing having a hexagon socket to fit #5, a wrench used in assembly of the unit.

★ ★ ★

**Figure 2** shows a cross section of the unit assembled and ready for use. In addition to providing adequate cooling and assuring a straight inline draw of the wire,

(*Please turn to page* 1271)

Arthur V. Hedman

A paper prepared for presentation at the Annual Convention of The Wire Association in Atlantic City, N. J., on October 15, 1958.

The author was born and raised in Surahammar, a prominent steel center in Sweden. He became affiliated with Wickwire Spencer in 1929. Mr. Hedman is a member of The Wire Association and of the Society of Carbide Engineers.

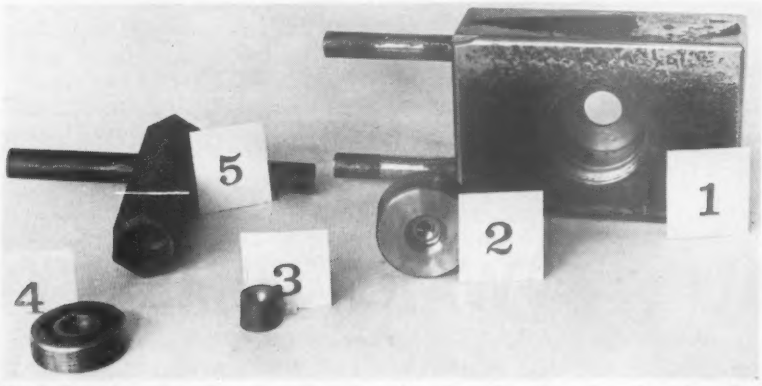



Figure 1

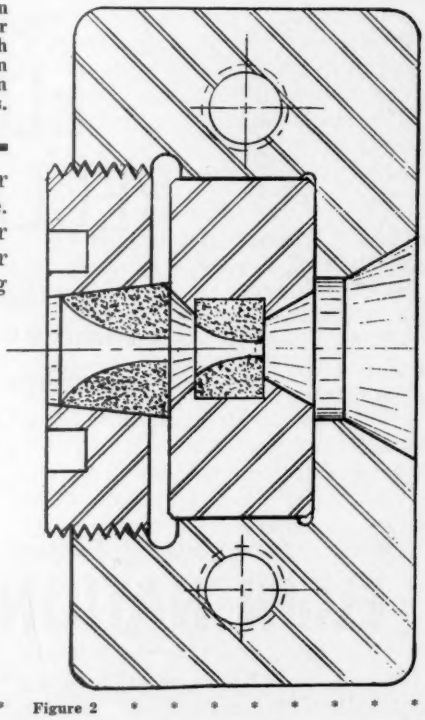
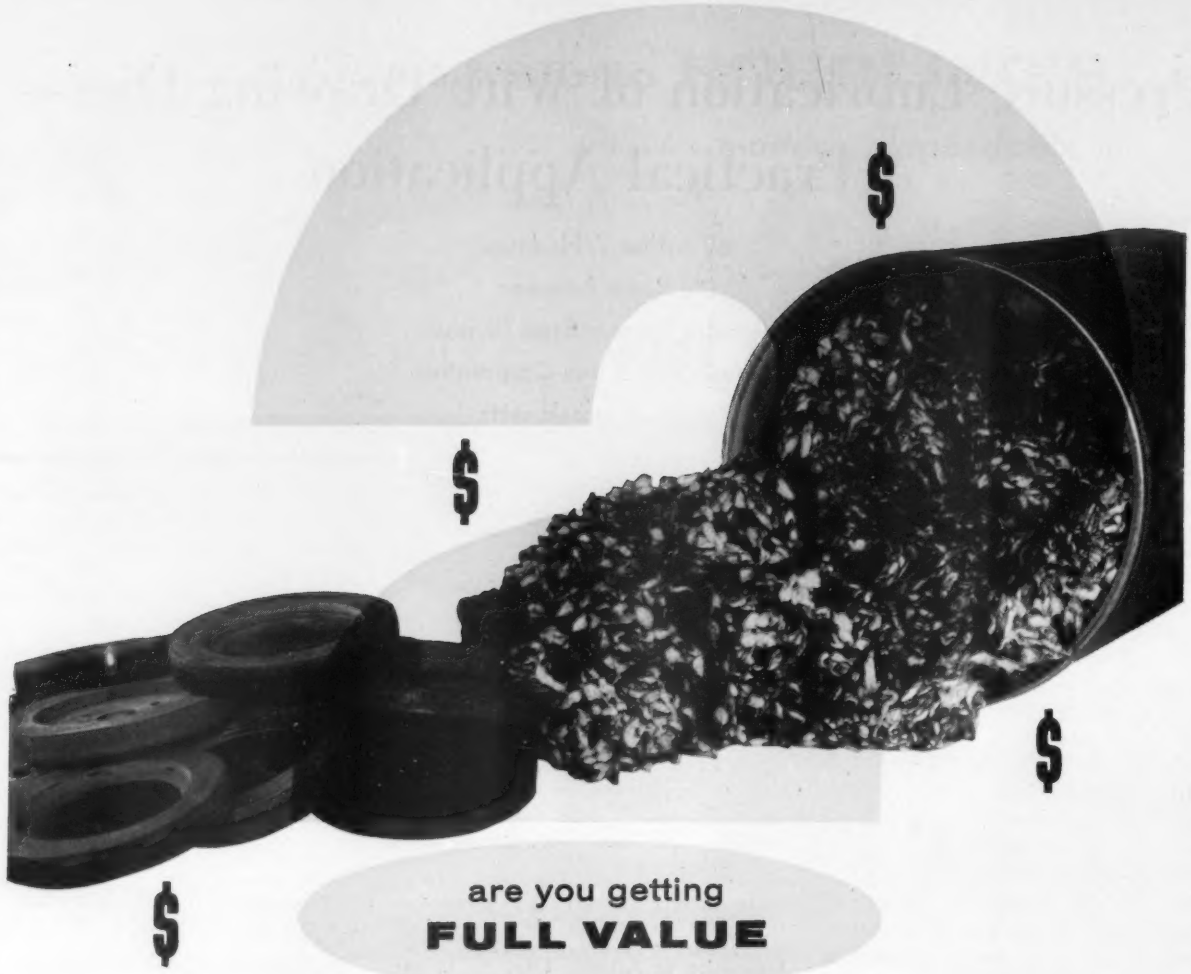


Figure 2

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# Polyethylene in Power Cables

by Michael M. Suba
Sales Manager, Extrusion Materials
Bakelite Company
Division of Union Carbide Corporation
New York, New York

**The** first application of polyethylene in electrical cables was undertaken in 1941. The material was then almost wholly restricted to use as an insulation for coaxial cables operating as radio-frequency transmission lines associated with radar and radio transmitting equipment. Throughout World War Two polyethylene insulated cables were used to carry voltages of 2300 through 33,000 in AC circuits.

★ ★ ★

**The** performance of polyethylene in this critical application is by now legendary among the people of the wire and cable industry, and an even larger portion of the population is aware that polyethylene-insulated radar cables played no small part in the winning of the great Battle of Britain. After experimenting with hundreds of insulating materials, British radar designers found that polyethylene alone provided the necessary high-frequency insulation combined with ability to withstand the shocks of combat. Polyethylene's role in this application was not a war-time triumph only, for it is still the preferred insulation material for these cables. The reasons for this acceptance are well-known to all of us in the wire and cable industry. Polyethylene offers a superior combination of physical, chemical and electrical properties. Paramount among these are polyethylene's electrical properties — its high AC and DC resistivity, high dielectric strength, low dielectric constant, and low power factor — which represent the most outstanding electrical properties of any flexible dielectric material. In addition, it is light in weight and easily extruded, offers excellent resistance to chemicals and to cracking and shattering at very low temperatures, and superior water and moisture resistance. Small wonder, then, that polyethylene was hailed as the most nearly ideal wire and cable insulation material available.

Michael M. Suba

**The author graduated from Rutgers University, class of 1939, with a Bachelor of Science Degree in Chemistry. He has been employed by Bakelite Company for twenty four years in various capacities, including Production, Development and Sales. He served in the New England territory for fifteen years as Technical Representative for the Wire and Cable Materials Division and for the Extrusion Materials Division, and became Sales Manager of the Extrusion Materials Division in March, 1957.**

**This paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City on October 15, 1958.**

★ ★ ★

**So** distinguished was polyethylene's war-time service in radar cables — under conditions presenting as rugged a test for a new material as any laboratory technician could conceive — that at the war's end electrical engineers and representatives of the plastics industry began to explore the dazzling possibilities of the new material, re-examining existing insulation and jacketing constructions to see where the new material could be employed. Naturally, an immense amount of scientific investigation had to be done before polyethylene could be applied to these applications.

★ ★ ★

**Before** a new plastic material which has been successful in one application can be applied to other wire and cable uses, close and thorough evaluation of the material in conjunction with cable design is needed. Proper engineering design is needed to take advantage of the inherent properties of the material —and this can be properly achieved only by testing the design under service conditions. A major step forward was taken in exploiting the possibilities of this new material when another division of Union Carbide Corporation expressed to Bakelite Company a desire for polyethylene insulated power cables. This was an opportunity to leap ahead in polyethylene technology and we were quick to seize it, recognizing that this provided a unique way of observing the performance of cable designs employing polyethylene under the conditions of actual service on a scale which no laboratory could duplicate.

★ ★ ★

**Union** Carbide Chemicals Company needed a cable of a construction offering advantages over cables of conventional construction to be used in certain chemical areas. They came to Bakelite Company for assistance in developing a cable to meet their needs. We went to the cable manufacturers with our problem and interested them in the project. With their co-operation, polyethylene was extruded on copper conductors to create the first power cable insulated with this material. This was in 1944 and the cable was established as a 3000 volt construction installed on a 2300 volt underground system in the South

Charleston, West Virginia chemical plant. The cable was installed in ducts and operated under the exceptionally severe service conditions characteristic of chemical installations. This cable has been in continuous service since 1944 and there has been no cable failure. The circuit availability has been 100 per cent.

★ ★ ★

**Since** the time of this initial installation, close to one million feet of cables using polyethylene coverings, ranging from 600 volt to 15 KV service, have been installed in various operating divisions of Union Carbide Corporation. The performance of polyethylene in these installations has been excellent. Its superior electrical properties and its excellent resistance to hazardous environmental conditions of acids, alkalis, and oils have been conclusively demonstrated. The story of this experience has been presented before various wire and cable organizations and is familiar to many of you. A notable account is contained in the paper "The Use and Performance of Polyethylene Power Cable in Chemical Plants", by Messrs. **G. O. Wardrop** and **J. C. Norton**, presented at the Winter Meeting of the AIEE in 1957.

★ ★ ★

**There** were some problems in the early stages of our experience, of course, as there must be in all ventures into the unknown. The first usage of polyethylene in power cables was made without complete knowledge of the physical properties of the material. It is remarkable that the cables constructed during the years 1944-1946, based on the knowledge available at the time, have given such good results. A number of physical properties were recognized but not completely understood. It was expected that these properties would seriously affect the cables. In this regard, so-called "cold flow" and "stress cracking" were most often discussed. These characteristics are still important and must be watched, but by the proper choice of "kinds" of polyethylene, these characteristics can be reduced in importance and will not limit cable performance. With the passage of time, our technology has been catching up with our aspirations for polyethylene power cables, narrowing the gap between promise and achievement to the point where we can now offer reliable and comprehensive engineering data and information on the use of polyethylene for power cables. And with the advent of the new polyethylene polymers, just about all of the design limitations remaining will be overcome.

★ ★ ★

**The** manufacture of a successful power cable insulated with polyethylene is due to the cooperative development effort of both the materials supplier and manufacturers. The program of investigation undertaken by Bakelite Company in 1944, in cooperation with the wire and cable manufacturers, has paid off in the development of the knowledge and the technical know-how needed to design and construct cables for higher voltage power distribution. This has been a three-way experiment, and in this venture the role of the wire and cable manufacturer has been of great importance. Bakelite Company has developed and evaluated the materials specifically designed for the application. The cable manufacturers have taken this material and subjected it to their tests and fabrication procedures. They have gained knowledge and have arrived at construction details enabling them to fabricate a suitable product. And the third member of this program, the user of the cable, has benefited from the advantages inherent in the new construction.

★ ★ ★

**This** progress in know-how on the part of the polyethylene materials supplier has included such factors as more accurate and detailed control over product and production procedure. At the same time, different "grades" of the material became established and the physical properties known. The recognition of product by molecular weight variations qualified the types of polyethylene best suited for cable insulation. Along with this, it was determined that polyethylene could be compounded to a limited degree with other materials. In this manner specific types of material for specific uses were produced.

★ ★ ★

**Possible** uses of polyethylene in power transmission and distribution wire and cables are as follows:

**Lead Sheath protection.**
**Insulation for line voltage wires and cables, particularly for control and signaling.**
**Sheath over insulation.**
**Line wire.**
**Distribution power cables up to 15 KV.**
**High voltage cables.**
**Luminous sign cable, ignition wire, and other applications (GTO).**

★ ★ ★

**We** would like to focus our attention on polyethylene for distribution cables and higher voltage cables.

★ ★ ★

**Polyethylene** insulated power cables used for distribution purposes by electrical utilities, while not having been utilized in such large quantities and in so many locations are now receiving serious consideration and increased acceptance based upon the satisfactory experience in the chemical industry. Case histories in the utility field include a few installations such as aerial and underground primary distribution circuits (principally residential) on a somewhat limited and experimental basis. Polyethylene is receiving ever-increasing consideration for distribution circuits where the environmental conditions of a chemical or refinery plant are not present, as replacements for such well-established types of insulation as paper, rubber, and varnished cambric. There are a number of interesting technical reasons for this shift to polyethylene in such applications, including reduced weight and dimensions, but the principal attraction involves economics.

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**Figure I*** illustrates today's approximate price relationship for similar typical sizes of 5KV rated power cables with copper as well as aluminum conductors covered with ozone-resistant rubber, paper, varnished cambric and polyethy-

* This and subsequent Figures are taken from R. C. Graham's paper, delivered before the AIEE 1957 Winter Meeting, "The Polyethylenes for Higher Voltage Cables," and are used with the permission of the author.

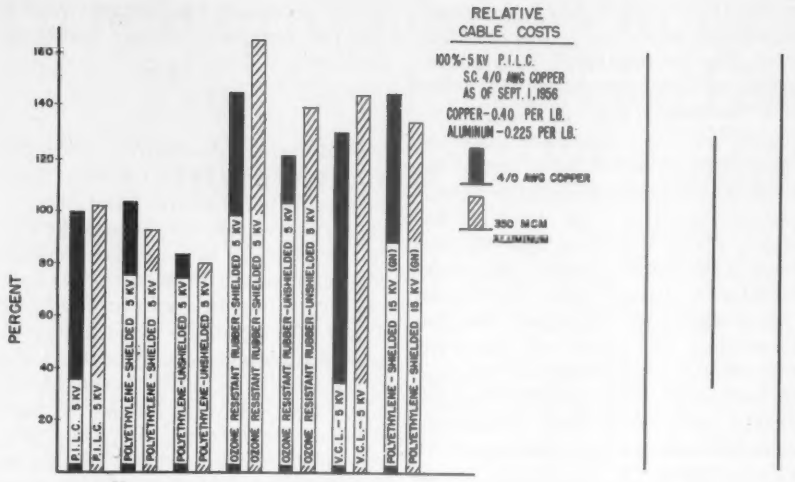


FIGURE 1

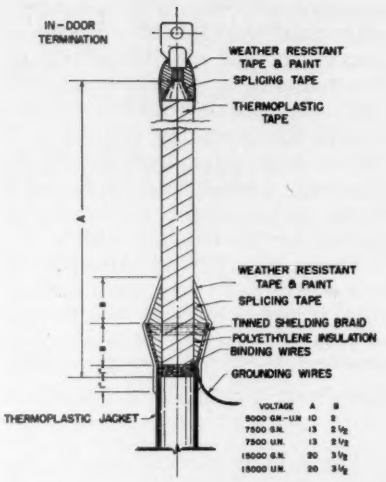


FIGURE 3

lene insulations. Since there is only a moderate difference in current carrying capacities, we may evaluate all of these on an equal conductor size basis for all practical purposes. Several interesting facts are evident in an analysis of this illustration:

★ ★ ★

**Polyethylene** insulated cables provide by far the lowest cost unshielded non-metallic sheathed type of cable available today for this voltage range.

★ ★ ★

A 5 KV **shielded** polyethylene insulated cable costs less than a 5 KV **unshielded** rubber insulated cable.

★ ★ ★

**Polyethylene** insulated cables are over 25 per cent less costly than equivalent rubber insulated designs.

★ ★ ★

**The** lowest initial shielded cable cost involves P.I.L.C. (paper insulated lead covered) which in the 5 KV range is about 5 per cent less than shielded polyethylene. However, this differential could well be eliminated if evaluated on a "final installed" basis since the lighter weight and use of manual splicing and terminating methods for the polyethylene cable would provide appreciable savings in installation cost. Further, if a corrosion protective barrier or other coverings were added to the P.I.L.C., then even the initial cost of the polyethylene non-metallic sheathed cable would be less, since this latter cable would not ordinarily require such additional protection.

★ ★ ★

A 15 KV shielded polyethylene cable actually costs less than a shielded 5 KV ozone-resistant rubber insulated cable for **the same conductor size.**

★ ★ ★

**At** today's relative metal price for copper and aluminum, only polyethylene insulated cables reflect any savings by incorporation of the equivalent size of aluminum conductor. In other cables, particularly rubber and V.C.L., the increased cost of coverings on the increased conductor dimensions more than off-set the relative metal savings whereas the lower covering costs for the polyethylene cables permit some metal savings. Of course, these differences will vary and are greatly dependent upon size and voltage rating.

★ ★ ★

**Such** economics warrant serious consideration of polyethylene insulated cables for the popular problem of a lowest cost direct burial

POLYETHYLENE INSULATED—THERMOPLASTIC JACKETED CABLES

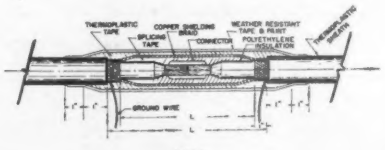


FIGURE 2

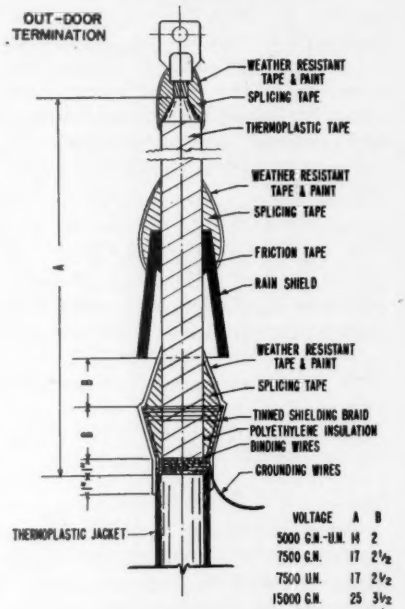


FIGURE 4

primary system for residential distribution.

★ ★ ★

**The** design and manufacture of a polyethylene insulated power cable follows conventional principles except that special precautions must be observed to eliminate the presence of any voids and to guard against their formation in service. Excessive or continued ionization (corona discharge) in such voids produces an "eroding" effect that may lead to an eventual concentrated thermal failure due to heat of the arc. This effect has sometimes been referred to as ozone cutting; actually this is a fallacy

since polyethylene possesses inherently excellent resistance to ozone. Because of the possible effects of internal corona it is recommended that only a cable which is corona-free at the operating voltage both before and after load cycles be specified. Production corona level tests, as conducted at the cable factory on the finished cable in accordance with IPCEA Appendix Q procedures, help to ensure against such trouble. Failures due to this or similar causes on cable designed and produced in such a manner have been practically unknown.

★ ★ ★

**The** first important step in the design of a satisfactory insulated power cable for the higher voltage ratings involves the use of a semi-conducting conductor shielding layer that is either adequately adherent to the polyethylene insulation or is one which may expand and contract at approximately the same rate as the insulation under load cycles.

★ ★ ★

**Next,** it is essential that the specified wall thickness of polyethylene insulation be extruded in such a manner so as to prevent any internal voids, bubbles or strain. This requires a carefully controlled and gradual cooling of the insulation immediately after it leaves the die of the extrusion machine.

★ ★ ★

**Where** external shielding is required, it is important to again utilize one of the various special methods to ensure a corona-free cable at all times.

★ ★ ★

**Where** maximum protection is desired, a jacket should be used. Polyethylene is finding extensive use as a corrosion protective jacket, both in lead-sheathed cables and in non-metallic sheathed constructions. On non-metallic sheathed cables the polyethylene jacket may be applied over the insulated core or shield as the case may be. Special polyethylene compounds have been developed for this purpose, consisting of high molecular weight polyethylene (for resistance to environmental stress cracking) and a small percentage of well-dispersed carbon black for maximum weather and sunlight resistance. Such jacketing materials offer many advantages over the conventional polychloroprene elastomeric type of jacket now commonly used on many power cables. Polyethylene provides equivalent weathering properties, superior cold bend and impact properties, superior moisture resistance, higher surface and volume resistivity (wet or dry), improved resistance to oil and chemicals, better abrasion resistance, less deformation at operating temperature, lower coefficient of friction which means easier pulling, lighter weight and lower cost. Polyethylene also eliminates the "second" vulcanization if the insulation is rubber.

★ ★ ★

**Polyvinyl** chloride has also been used with considerable success as a jacket on polyethylene insulated high voltage cable. The choice as to p.v.c. or polyethylene as the jacketing material is a matter of selection for the particular use and the area involved. Where flame resistance is required, p.v.c. is recommended as the jacketing material.

★ ★ ★

**Because** of economy and the advantages of longer lengths, polyethylene-insulated power cables are generally preferred in a single conductor arrangement although multiple conductor assemblies may be satisfactorily designed and produced. IPCEA Appendix P gives recommended thicknesses, ratings, tests, etc. for power cables through 5 KV rating and it is expected that this will be extended through 15 KV. The insulation thickness of the polyethylene has thus far been established as approximately 70 per cent of the recommended thickness for rubber insulation which approximates dimensions of solid oil impregnated paper insulated cable. This results in the comparative dimensions and weights for power cable as illustrated in Table I which indicates the possibility of easier and longer pulling lengths for polyethylene insulated and jacketed cable.

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**Installation** procedures for polyethylene insulated constructions are relatively simple and low in cost. Where polyethylene jacketing is employed, no special pulling lubricant other than water is needed for pulling in ducts or conduits. When pulling cable having a p.v.c. jacket, it is recommended that the cable be lubricated with soapstone. For aerial, direct burial or submarine insulations the same precautions or methods should be observed as for conventional non-metallic sheathed insulated cable.

★ ★ ★

**Manual** splicing and terminating methods have proved satisfactory for polyethylene power cable—pot-heads are seldom required except for some special insulation advantage. A study was conducted by Bakelite Company on potting compounds for possible use in the termination of 4160 volt polyethylene insulated power cables in pot-heads. Epoxies, polyethylene, and asphaltic (petroleum based) compounds were studied and it appears that "Keneflex X" petroleum based compound is the most satisfactory potting compound presently available.

★ ★ ★

**Figure** 2 illustrates a suggested splicing procedure for shielding cable. The splicing tape is a special self-sealing polyethylene based material that resembles and handles like a rubber splicing tape. Distance "L" varies from 8 to 10 inches on 5 KV cable and 13 to 16 inches on 15 KV cable. Figure 3 illustrates a manual procedure for make-up of indoor terminations and Figure 4 illustrates an outdoor terminal.

(*Please turn to page* 1270)

TABLE I

Single Conductor 500 MCM Copper, 15 KV Grounded Neutral

| Cable Type | Approximate O. D. (inches) | Approximate Weight (lbs. per 1000 ft.) |
|---|---|---|
| P.I.L.C. | 1.42 | 4100 |
| Polyethylene | 1.60 | 2350 |
| Butyl Rubber | 1.80 | 2700 |
| V.C.L. | 1.57 | 4150 |

# Preheating Conductors in Extrusion Insulating Processes by Copper Loss Method— Temperature as a Function of Current

by J. W. Lechleider
Bell Telephone Laboratories, Inc.
Murray Hill, New Jersey

A paper prepared for presentation at the Annual Convention of The Wire Association in Atlantic City, N. J., on October 14, 1958.

## Description Of The Process

If plastic insulation is extruded onto a conductor which has not been preheated, the shock cooling of the hot plastic as it comes in contact with the conductor normally results in shortness or lack of elongation in the insulation. To prevent this condition some form of preheat is usually provided.

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There are several methods of preheating conductors. However, the one which we are concerned with uses the heating effect of a current passing through the wire. This technique is illustrated schematically in Figure I (attached) and in the accompanying photograph. A low frequency alternating current (or a direct current) is passed through a short section of the wire between two copper pulleys which are a short distance before the extruder. The currents involved are usually large, 150 amperes being typical. The process is simple in appearance, but the heat transfer problem associated with it is somewhat more complicated.

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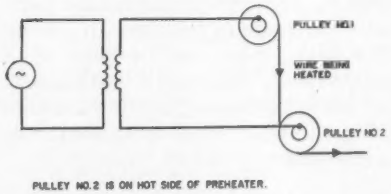
Since different extrusion conditions involve different wire speeds, conductor diameters, and preheating requirements, it can be seen that an analysis of the heat transfer processes in preheating by using the conductor copper losses was in order.




PULLEY NO.2 IS ON HOT SIDE OF PREHEATER.

SCHEMATIC DRAWING OF PREHEATER IN EXTRUSION LABORATORY AT BELL TELEPHONE LABORATORIES
FIG. I

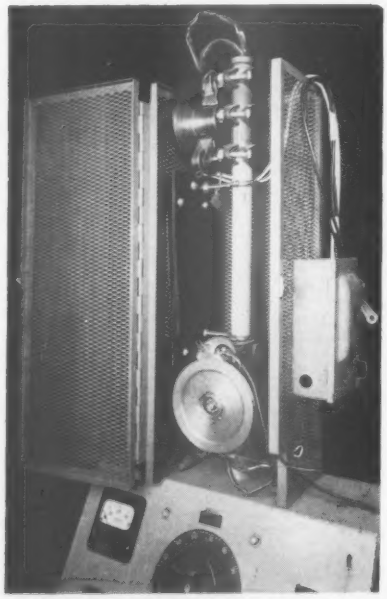
## The Problem of Determining the Temperature Rise Analytically

The heating of the wire by the current is a complicated process. As the wire passes over the first pulley of the preheater, current starts to flow in the wire. This current dissipates energy in the conductor (copper losses) according to the well known formula

$$P = I^2R \qquad (1)$$

This energy raises the temperature and resistance of the wire so that more energy is dissipated for a given current setting, which results in a greater rate of increase in temperature of the wire, and so on. There are a number of complicating effects which must be investigated in order to determine their importance in the process. These are:

1. Conduction of heat along the wire.
2. Radiation of heat from the wire to its surroundings.
3. Convection of heat from the wire to its surroundings.
4. Heating of the pulleys by their own $I^2R$ losses and heat transfer between the pulleys and the wire.
5. Current passing to ground from either pulley.
6. Variation of current with time (alternating current).



Preheater in Extrusion Laboratory at Bell Telephone Laboratories.

★ ★ ★

Because the wire is usually small in diameter and only spends a short time in the preheater, heat conduction and radiation are neglected.

★ ★ ★

Since the air a short distance away from the wire in the preheater is relatively still, heat transfer by convection will be essentially of the free convection type and is hence neglected.

★ ★ ★

Since the wire will be colder than the first pulley it passes over in the preheater, the first pulley will heat the wire. Similarly, the wire will be hotter than the second pulley in the preheater and hence the wire loses heat to that pulley. Hence, the effect of heat transfer between the pulleys and the wire tends to cancel out, even though it is small in the first place.

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It is assumed that the resistance

of the length of wire between the pulleys in the preheater is much less than the resistance of the length of wire between either pulley and ground. Hence, the effects of stray currents (Item 5, above) can be neglected. All the above assumptions appear to be valid on the basis of rough calculation.

★ ★ ★

The effect of using a-c current will be discussed later in this paper, but is tentatively neglected.

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Now, in the wire, electrical energy is converted into heat which is stored in the wire. This rate of storing heat is given by the familiar formula $P=I^2R$. The resistance of the wire (R) varies linearly with temperature as indicated by the formula

$$R = R_o + \alpha(T-T_o) \qquad (2)$$

where $R_0$ is the resistance of the wire when its temperature is $T_0$, R is its resistance at temperature T, and $\alpha$ is the temperature coefficient of resistance of the wire. With the assumptions made above, the problem reduces to the question: "What will be the temperature of the wire as it leaves the preheater, as a function of wire speed, wire size, preheater current, wire resistance, separation of preheater pulleys, and the temperature coefficient of resistance of the wire?" A mathematical analysis of this problem was made, a brief outline of which is appended. The results of the analysis are presented below.

## Results Of The Analysis

The analysis indicates that the preheater current necessary to raise the temperature of the wire an amount $\triangle T$ is given by

$$I = A\sqrt{\frac{CV\delta}{\alpha\rho_o L}\ln[1+\alpha\triangle T]} \qquad (3)$$

In Equation (3),

- $A$ = cross-sectional area of wire in square ft.
- $C$ = specific heat of wire in Watts/-lb. °F.
- $V$ = wire speed in feet/sec.
- $\alpha$ = temperature coefficient of wire in ohms/°F.
- $\delta$ = density of wire material in lbs./ft³.
- $\rho_o$ = resistivity of wire material before it enters the preheater in ohm ft.
- $L$ = Free length of wire between preheater pulleys in feet.
- $\triangle T$ = wire temperature rise in the preheater, °F.

★ ★ ★

If the change in resistance of the wire in the preheater is small

$$(\alpha\triangle T \leq 1)$$

then Equation (3) can be written in the approximate form

$$I = A\sqrt{\frac{2CV\delta\triangle T}{\rho_o L[2+\alpha\triangle T]}} \qquad (4)$$

★ ★ ★

If copper wire is being preheated, and the temperature of the copper is on the order of 80°F before being heated, then Equation (4) becomes

$$I = 9.7 \times 10^{-4} D_1^2\sqrt{\frac{V_1\triangle T}{L_1(2+.00218\triangle T)}} \qquad (5)$$

where

- $I$ = preheater current in amperes.
- $V_1$ = wire speed in ft./min.
- $L_1$ = Free length of wire between preheater pulleys in feet.
- $\triangle T$ = wire temperature rise in °F.
- $D_1$ = wire diameter in mils.

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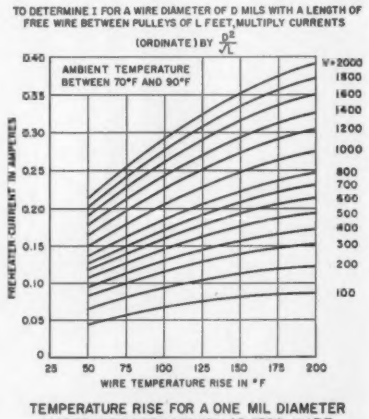
A family of curves showing the current necessary to produce a given temperature rise in copper wire of one mil diameter with a pulley spacing of one foot and an ambient temperature between 70°F and 90°F is attached (Figure II).



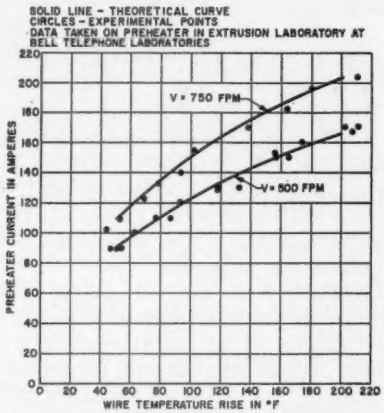

TEMPERATURE RISE FOR A ONE MIL DIAMETER COPPER WIRE WITH LENGTH OF FREE WIRE BETWEEN PULLEYS OF ONE FOOT
FIG. II

## Experimental Verification of Theoretical Results

The temperature rise in the preheater was measured by measuring the resistance of the wire as it left the preheater. This was done by passing the wire over four wiping fingers that served as contacts for a Kelvin Bridge. The resistance increase for various preheater currents was then converted to temperature rise data by using Equation (2) in the form

$$\triangle T = \frac{\frac{R}{R_o} - 1}{\alpha}$$

Using this technique, the preheater temperature rise as a function of preheater current was determined experimentally for wire speeds of 500 ft./min. and 750 ft./min. These experimental results are compared graphically with theoretical temperature rises in Figure III (attached). It is seen that the agreement between theory and experiment is good.


SOLID LINE - THEORETICAL CURVE
CIRCLES - EXPERIMENTAL POINTS
DATA TAKEN ON PREHEATER IN EXTRUSION LABORATORY AT BELL TELEPHONE LABORATORIES
V = 750 FPM
V = 500 FPM
PREHEATER CURRENT IN AMPERES
WIRE TEMPERATURE RISE IN °F

COMPARISON OF THEORETICAL AND EXPERIMENTAL WIRE TEMPERATURE RISE
FIG. III

## The Effect of Alternating Current

If the wire speed is high enough, using alternating current of low enough frequency may cause periodic variation of temperature along the wire. This can be seen by a glimpse at Figure IV (attached) which is just a plot of the variation of a 60 cycle alternating current with time.

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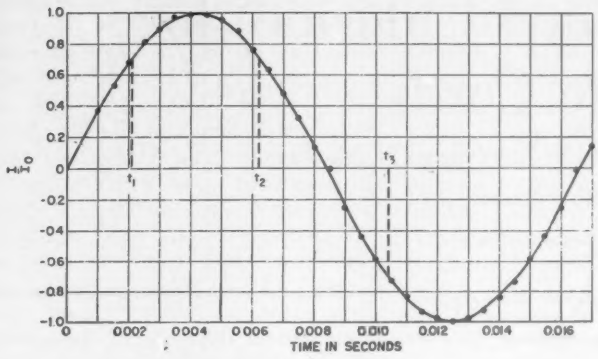
As a typical example suppose the wire speed is such that it takes a




VARIATION OF 60 CYCLE CURRENT WITH TIME
FIG. IV

point on the wire .00417 seconds (one fourth of a cycle) to go through the preheater. Then, it is apparent that a cross-section of wire that enters the preheater at time $t_1$ and leaves at time $t_2$ will have a greater average current passing through it (and hence a greater temperature rise) than a wire cross-section that enters at time $t_2$ and leaves at time $t_3$. A close look at the mathematics of the situation shows that the variation of temperature along the wire is given by

$$\frac{T_{max} - T_{min}}{\Delta T_{avg.}} = \frac{2 \left| \sin \frac{(\omega L)}{(V)} \right|}{\frac{\omega L}{V}} \qquad (6)$$

where

$T_{max}$ = maximum temperature along the wire

$T_{min}$ = minimum temperature along the wire

$\Delta T_{avg}$ = average temperature rise in the preheater

$\omega = 2\pi f$

f = frequency of applied current in cycles per second

V = wire speed in feet per second

L = preheater pulley separation in feet

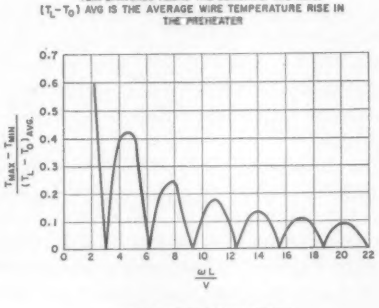
The temperature maxima and minima along the wire are separated by a distance

$$\Delta L = \frac{V}{4f} \qquad (7)$$

As a practical example, if the wire speed is 1920 feet per minute and a standard 60 cps current is applied to a preheater which has a pulley separation of two feet, then the variation of temperature along the wire is 8.5% of the average temperature rise in the preheater; the maximum and minimum temperatures are separated by a distance of 1.6 inches.

★ ★ ★

A plot of the variation of wire temperature with $(\frac{\omega L}{V})$ is attached (Figure 5). An inspection of this plot shows that periodic variation of temperature along the wire can be completely eliminated at any wire speed and any current frequency by proper adjustment of the distance between preheater pulleys. Of course, this difficulty could be avoided by using a d-c voltage supply if one is available that will supply the large currents necessary in the preheater.




PERIODIC TEMPERATURE VARIATION ALONG WIRE
FIG. V

## Appendix
### Derivation of Formulae

If a current I is flowing through a wire, heat is supplied to the wire at a rate

$$Q_{in} = I^2 r \qquad (A\text{-}1)$$

where r is the resistance per unit length of wire. If the temperature of the wire is increasing at a rate

$$\frac{dT}{dt},$$

then heat is being stored in the wire at a rate

$$Q_s = CA\delta \frac{dT}{dt} \qquad (A\text{-}2)$$

★ ★ ★

To conserve energy, the heat supplied by the copper losses (A-1) must equal the heat stored in the wire; that is,

$$Q_{in} = Q_s \qquad (A\text{-}3)$$

or

$$I^2 r = CA\delta \frac{dT}{dt} \qquad (A\text{-}4)$$

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Now, the resistance is a function of temperature:

$$r = r_o + \alpha(T\text{-}T_o) \qquad (A\text{-}5)$$

Thus, Equation (A-4) may be written

$$I^2(r_o + \alpha(T\text{-}T_o)) = CA\delta \frac{dT}{dt} \qquad (A\text{-}6)$$

or,

$$I^2 dt = \frac{CA\delta \, dT}{r_o + \alpha(T\text{-}T_o)} \qquad (A\text{-}7)$$

★ ★ ★

Integrating (A—7),

$$\Delta T = C_1 \exp\left(\frac{\alpha I^2 r_o(\Delta t)}{AC\delta}\right)^{\frac{1}{\alpha}} - \frac{1}{\alpha} \qquad (A\text{-}8)$$

★ ★ ★

When $\Delta t = o$, $\Delta T = o$ thus,

$$C_1 = \frac{1}{\alpha}$$

Thus

$$\alpha\Delta T = \exp\left(\frac{\alpha I^2 r_o(\Delta t)}{AC\delta}\right) - 1 \qquad (A\text{-}9)$$

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Now, $\Delta t$ is the time spent in the preheater. Thus,

$$\Delta t = \frac{L}{V}$$

L = free length of wire between preheater pulleys in feet.

V = wire speed. (ft./sec.)

★ ★ ★

Also, the specific wire resistance is related to the volume resistivity

(*Please turn to page* 1265)

# Plasticized Poly(Vinyl Chloride) for Retractile Cords

by J. B. DeCoste, J. B. Howard, V. T. Wallder, H. M. Zupko

Bell Telephone Laboratories, Inc.

Murray Hill, New Jersey

This paper was prepared for presentation at the Annual Convention of The Wire Association in Atlantic City on October 15, 1958.

## Introduction

**This** investigation was undertaken for the purpose of obtaining information which could be used in developing poly(vinyl chloride) jackets for spring telephone cords. With the advent of plastic telephones in color,[15] it became necessary to find a flexible material for jacketing cords that could be furnished easily in a full range of colors. Poly(vinyl chloride) plastics met these requirements and their use in straight cords presented no problem. Their slow retraction was objectionable in spring cords, however. The vinyl plastics available for coating wire and cable were either too stiff or too slow acting, or were unusable for other reasons such as a lack of resistance to oil extraction or a tendency to mar lacquer. In a satisfactory jacketing material all of these factors must be reconciled, but in this paper only the question of elasticity is considered.

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**The** elasticity of a material is usually judged by the speed with which it is able to recover after being deformed. For a material to be classified as elastic it must upon unloading retain no permanent set[6]. Vinyl plastics meet this requirement loosely, but deviate from the behavior of ideal elastic materials in that they exhibit a retarded elastic response[2]. The properties of springs made with rigid, high modulus, reinforced polyester and epoxy plastics have been reported by Reinhart and Newman[9] but there is a scarcity of information concerning non-rigid plastics for such applications. To obtain information which would be helpful in solving the retractile cord problem, a test method for measuring the elastic properties of vinyl plastics was devised using a small helical test specimen. By screening experimental materials under a selected set of conditions it has been possible to determine, in advance of actual cord trials, whether a material has satisfactory elastic properties, and through the information thus obtained it has been possible to formulate poly(vinyl chloride) spring cord jacketing materials with satisfactory retractile properties.

## Retarded Elastic Response

**When** 35-40% by weight of plasticizer is incorporated with a poly(vinyl chloride) resin, a product exhibiting rubberiness within a certain range of external conditions of temperature, stress, strain, and time is obtained. This material is characterized by a low modulus (200-300 psi) and a long-range reversible extensibility (300-400%). The rubbery state, according to Mark[10], is an intermediate region between the liquid and crystalline states of long-chain linear molecules where local motion may take place involving individual segments without over-all displacement of the entire molecule. Stickney and Cheyney[11] have stated that they believe a condition exists in plasticized poly(vinyl chloride) wherein most of the strongly polar points of the polymer molecules have been effectively neutralized by plasticizer molecules, with those remaining serving somewhat like the cross-links in vulcanized rubber. The presence of some form of three dimensional network in these materials under normal ambient conditions is indicated by the complete recovery which occurs after even prolonged deformation.

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**When** a vinyl plastic is held under a constant strain for some time and then released, as in extension of the jacket of a spring cord, it reacts as illustrated in Figure 1.

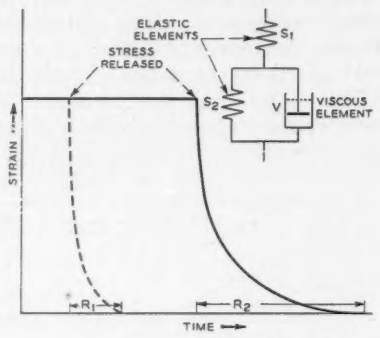



FIG. 1
PLASTICIZED POLY (VINYL CHLORIDE) RECOVERY DEPENDANCE ON TIME

Recovery times $R_1$ and $R_2$ are a function of the loading period; the longer the loading time the slower the recovery. A mechanical analogy in which springs represent ideal elastic elements and a dashpot the coexisting viscous element may be helpful in understanding this phenomenon. There is always some immediate response represented by spring $S_1$, while the retarded response is represented by spring $S_2$ and dashpot V. When the dashpot is stressed, it yields. The more it yields, the slower the system will be to recover.

## Experimental

**All** of the compositions were expressly prepared for this in-

vestigation. Unless otherwise indicated a homopolymer vinyl chloride resin with an intrinsic viscosity of 1.24 in cyclohexanone at 30°C was used. Mixing was done by conventional hot roller mill technique and test sheets were prepared to a thickness of 0.075″ ± 0.010″ by compression molding. With the exception of the samples in which plasticizer concentration was varied, the following base formulation was used throughout:

TABLE I

| Base Formulation | Parts by Weight |
|---|---|
| Poly(vinyl chloride) resin .... | 100.0 |
| Plasticizer ..... | 66.6 |
| Epoxy Stabilizer ..... | 5.0 |
| Stearic Acid ..... | 0.8 |
| Barium Laurate ..... | 2.5 |

### *Helix Test Specimen*

A small helical specimen has been employed for determining the recovery rate and an apparent modulus of rigidity. The recovery rate is obtained from the time required for the helix to retract from a given extension. The modulus is determined from the extension produced by a known load. These are nondestructive tests and the same specimen may be used for both provided a relaxation period is allowed.

★ ★ ★

The helical specimen is prepared in a manner similar to that used in fashioning spring cords. In this process straight cordage is wrapped on a mandrel and heated for a short time to a temperature where flow begins; this is in the range of 130-150°C. After this treatment the assembly is cooled to room temperature and the finished cord is removed from the mandrel. The feasibility of making cords by this process, in which the elasticity of the vinyl plastic is the sole source of action, the first demonstrated by one of the authors[14] in 1951. Techniques for enhancing retractibility by pretwisting[7] the cord prior to forming or by reversing the turns after forming[5] may be used. These latter procedures are not employed in making test specimens.

★ ★ ★

The helical specimen is prepared from a strip of molded sheet measuring 5″ x 0.25″ x .075″. The strip is wrapped in close turns around a 0.25″ diameter wooden dowel, to which it is fastened. The assembly is heated for 30 min. at 130°C, after which it is cooled to room temperature and the helix removed. See (A) and (B) of Figure 2. Slight blocking between turns often occurs, and before a specimen is used all turns must be freed.

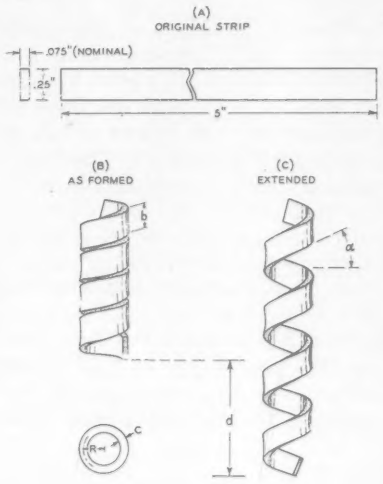



FIG. 2

On occasion, heat-shock cracks have occurred while forming the specimens at 130°C. This trouble can often be cured by proper molding at a slightly higher temperature; a good general molding temperature has been found to be 170°C. Heat-shock cracks have also been found to be a difficulty inherent with certain plasticizers. This shortcoming obviously eliminates such materials from further consideration.

### *Recovery Test Procedure*

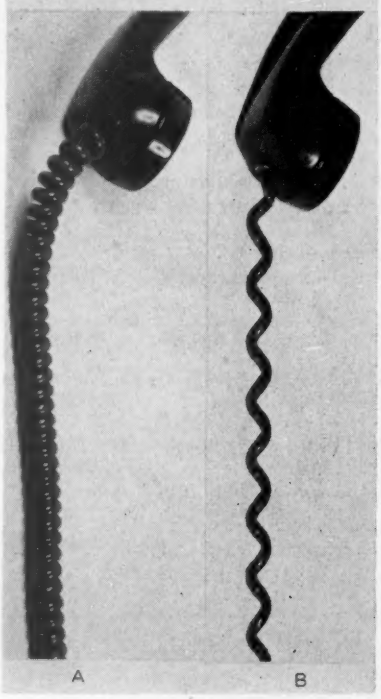
The recovery time $R_t$ is determined by elongating the helix, held in a vertical position, 8 cm. beyond its original length, holding it for 30 seconds and then releasing it. During extension the helix is held at either end by spring clips which prevent untwisting. The recovery time is observed in seconds using a stopwatch. In order to express the data as a rate in whole numbers a recovery index was defined as

$$\text{Recovery Index} = 1/R_t$$

where $R_t$ = recovery time in kiloseconds

The above test conditions were selected to approximate the way a spring cord is stretched in use as shown in Figure 3.

FIG. 3
POLY (VINYL CHLORIDE) JACKETED SPRING TELEPHONE CORD, (A) RETRACTED, AND (B) EXTENDED




### *Modulus Test Procedure*

The apparent modulus of rigidity is determined by measuring the extension of the helix after a known load is applied for five seconds. In this test a free hanging load is used and some untwisting occurs; this is expected and is taken into account. Loads are confined to those yielding deflections between 50-150%. Equation (1) for the modulus of a rectangular section spring was derived from relationships set down by Timoshenko[12] [13]. The modulus has been referred to as "apparent" because it represents only one point in the time-deformation cycle of a retarded elastic material. The $(\sin^2\alpha/IE)$ portion of equation (1), which takes into account flexural bending, contributes a negligible amount to the modulus of rigidity, G, and was eliminated in equation (2) used for all cal-

culations. The relationship between $\alpha$ and $\delta$ was determined empirically using sample 372-57 and assumes that other materials will give similar angles for the same deflection.

$$(1)\quad \delta = PR^2 s \left( \frac{\cos^2\alpha}{GI_p} + \frac{\sin^2\alpha}{EI} \right)$$

$$(2)\quad G = \frac{PR^2 s \cos^2\alpha}{\delta I_p}$$

Where:

$G$ = modulus of rigidity, psi
$\delta$ = extension, inches
$\alpha$ = helix angle
$= 21 + 12.7\,\delta$
$E$ = tensile modulus, psi
$R$ = radius of the helix, inches (See Figure 2)
$P$ = load, lbs.
$s$ = length of unwound strip, inches
$I = \frac{c\,b^3}{12}$ = bending moment of inertia of the cross-section of the helix
$I_p = \beta\, b\, c^3$ = polar moment of inertia of the cross-section of the helix
$b$ = width of side, inches (See Figure 2)
$c$ = thickness, inches (See Figure 2)
$\beta$ = constant from Table II below

TABLE II

| b/c | 1.00 | 1.50 | 1.75 | 2.00 | 2.50 | 3.00 | 4.00 | 6.00 | 8.00 | 10.00 |
|---|---|---|---|---|---|---|---|---|---|---|
| $\beta$ | 0.141 | 0.196 | 0.214 | 0.299 | 0.249 | 0.263 | 0.281 | 0.299 | 0.307 | 0.313 |

### *Accuracy and Precision*

The procedure adopted for obtaining recovery values is best suited to materials with an $R_t$ between 2.0 and 200 seconds. Materials faster than 2.0 seconds cannot be timed accurately and those slower than 200 seconds have too indefinite an end-point. It should be possible to use the helical specimen for evaluating materials outside the above mentioned limits but it would require a modification in procedure. Within the specified range, replicate determinations were made on 10 helices of a di-2-ethylhexyl phthalate (DOP) plasticized stock (372-57). The results given in Table III indicate that the reproducibility of the test, while not of the highest order, is satisfactory for distinguishing between materials acceptable and unacceptable in their retractile behavior for jacketing spring cords. Vinyls with a minimum recovery index of 90 are considered sufficiently elastic for this use. For comparative purposes a typical neoprene rubber compound, having of course a higher modulus than vinyls, gives a recovery index of 329.

TABLE III

| | Recovery Index | Apparent Modulus of Rigidity, G psi |
|---|---|---|
| Average, $\overline{X}$ (10 determinations) | 111 | 225 |
| Standard Deviation, $\sigma$ | 11.4 | 16.5 |

Prior to selection of the helix recovery test, consideration was given to the ASTM D-412 method for Tension Set[3] and the Bashore Resiliometer[4] as means of determining elastic recovery. The D-412 method lacked sensitivity, while the resiliometer did not correlate with spring performance. A method which was not tried but might have given good correlation is that of compression set as used by Morris and Hollister[8] for studying the recovery of plasticized rubber. For the evaluation of the apparent modulus of rigidity, the helix test serves only as an alternate to ASTM D-747 and D-1043[3]. By referring to Table IV it will be seen that the helix modulus correlates rather well with the values of G obtained by the other two methods. Among the advantages of using the helix method are (1) that errors due to friction are eliminated and (2) that no elaborate apparatus is required.

Table IV

APPARENT MODULUS OF RIGIDITY BY ASTM AND B.T.L. HELIX TEST METHOD

| | Temperature +23°C | | Temperature -20°C | |
|---|---|---|---|---|
| Sample* | ASTM D747-50** | B.T.L. Helix | ASTM D1043-51 | B.T.L. Helix |
| 527-57 (Epoxy) | 340 | 197 | 11,700 | 18,360 |
| 372-57 (DOP) | 320 | 290 | 4,960 | 5,200 |
| 20-55 | 320 | 300 | 4,290 | 5,730 |
| 3-58 (DOS) | 310 | 220 | 1,450 | 1,410 |

* See Table 2 for more complete description.

** Modulus of elasticity (E), converted to modulus of rigidity (G) by the equation: $G = 1/3E$. cf. appendix to ASTM D1043-51.

## Elasticity vs. Composition

### *Effect of Resin*

The two principal components of the elastomeric portion of a vinyl plastic are the resin and the plasticizer. Resins used for this purpose are either homopolymers or high vinyl chloride copolymers where variations important for present considerations are primarily in average molecular weight. The recovery properties of six homopolymer resins comprising the commercially available range of molecular weight and two copolymers were compared using di-2-ethylhexyl phthalate as the plasticizer. Referring to Table V it will be seen that no significant difference was found among the various resins. As far as recovery is concerned, therefore, the choice of resin does not appear to be a critical factor.

Table V

EFFECT OF RESIN VISCOSITY AND COPOLYMERIZATION ON RECOVERY

66.6 parts DOP per 100 parts resin

| Resin Description | | | |
|---|---|---|---|
| Designation | Type | Intrinsic Viscosity* | Recovery Index ($1/R_t$) |
| 371-57 | Homopolymer | 1.43 | 98 |
| 353-57 ** | " | 1.30 | 94 |
| 372-57 | " | 1.24 | 118 |
| 23-55 | " | 1.00 | 104 |
| 354-57 | " | 0.86 | 98 |
| 508-57 | " | 0.74 | 93 |
| 25-55 | 5% Acetate Copolymer | 1.15 | 98 |
| 399-57 ** | Maleate Copolymer | 1.15 | 98 |

* In cyclohexanone at 30°C

** Fine particle plastisol resins

These results conform with the pattern typical of high polymers. It is characteristic for physical properties to change rapidly with molecular weight at relatively low levels of the latter, and then to level off. After this stage has been reached further increase in chain length has little effect on most mechanical properties. Since long-chain polymers are essential for rubber-like elasticity it must be concluded that all of the resins in this study exceed the necessary minimum chain length and have reached the molecular weight pla-

Table VI

VARIATION IN RECOVERY AND MODULUS WITH PLASTICIZER

| B.T.L. Designation | Plasticizer 66.6 parts/100 parts PVC resin | Recovery Index (1/Rt) +23° | Recovery Index (1/Rt) -20°C | Apparent Modulus of Rigidity G, psi +23°C | Apparent Modulus of Rigidity G, psi -20°C |
|---|---|---|---|---|---|
| 370-57 | Nitrile rubber, H. Mol. Wt. | < 4. | | 740 | 93,900 |
| 382-57 | Nitrile rubber, L. Mol. Wt.* | 5. | | 750 | 71,900 |
| 14,19-55 | Polyester "X"* | 36. | | 480 | 41,700 |
| 7,19-58 | Polyester "Y"* | 73. | | 230 | 7,100 |
| 17-55 | Polyester "Z"* | 92. | | 320 | 6,600 |
| 378-57 | Diisodecyl | 53. | | 290 | 4,700 |
| 372-57 | Di-2-ethylhexyl ● - phthalate | 111. | | 225 | 5,200 |
| 18-55 | n-octyl n-decyl | 156. | < 3.0 | 270 | 2,000 |
| 377-57 | dibutyl | 238. | | 310 | 5,100 |
| 373-57 | di-2-ethylhexyl m-phthalate | 78. | | 350 | 5,900 |
| 380-57 | Proprietary o-phthalate | 69. | | 260 | 2,700 |
| 374-57 | Oxo-alcohol o-phthalate | 30. | | 650 | 7,200 |
| 2-58 | Didecyl-4, 5-epoxycyclohexane-1,2 dicarboxylate | 30. | | 290 | 10,000 |
| 527-57 | Epoxidized soya oil | 45. | | 160 | 18,400 |
| 20-58 | Epoxidized stearate | 102. | 5. | 230 | 790 |
| 6-58 | Diisodecyl adipate (DIDA) | 24. | < 3. | 310 | 2,400 |
| 3-58 | Di-2-ethylhexyl sebacate (DOS) | 63. | 5. | 220 | 1,400 |
| 45-58 | Proprietary sebacate | 82. | < 3. | 270 | 792 |
| 44-58 | Di-2-ethylhexyl azelate (DOZ) | 97. | < 3. | 240 | 856 |
| 4-58 | Dibutyl sebacate (DBS) | 241. | 35. | 280 | 410 |
| 15-55 | Tricresyl Phosphate | 69. | | 240 | 43,600 |
| 16-55 | Tri-2-ethylhexyl Phosphate | 121. | | 156 | 2,500 |
| 20-55 | 2-ethylhexyl diphenyl phosphate | 182. | | 300 | 5,700 |
| 375-57 | Proprietary aliphatic ester | 27. | | 340 | 28,700 |
| 5-58 | Pentaerythritol caproate | 52. | | 250 | 4,100 |
| 18-58 | Polyethylene glycol di-2-ethylhexoate | 100. | < 3. | 220 | 905 |
| 28-55 | Tetra-n-butyl thiodisuccinate | 152. | | 280 | 7,000 |
| 57-150 | Neoprene - Vulcanized | 329 | < 3. | 490 | 1,120 |
| 40-34 | Natural Rubber, Vulcanized | 504 | 94. | 43 | - |

*Viscous liquid polymers.

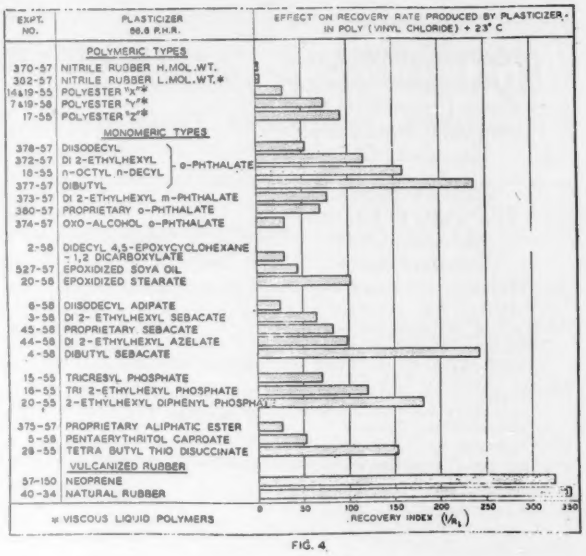



FIG. 4

teau where differences do not affect elasticity.

### *Effect of Plasticizer*

**The** critical effects of plasticizer variation on elasticity may be seen in the recovery and modulus data of Table VI and Figure 4. It is obvious that major differences exist among the results obtained with different plasticizers and also that most of the vinyls are much slower in recovery than the rubber reference samples. No particular type of plasticizer is outstandingly effective, and wide variation is found among the phosphates, phthalates, and straight chain aliphatics depending upon the esterfying alcohol. In cases where direct comparison is possible, the alcohol radicals in descending order of preference are butyl, di-2-ethylhexyl and diisodecyl. The best over-all performance was obtained with dibutyl sebacate, which approaches the vulcanized rubbers in response. This confirms the report of Aiken et al,[1] who found dibutyl sebacate to be a very efficient plasticizer for softening vinyl resin.

★ ★ ★

**Polymeric** plasticizers have a more limited recovery range than the monomerics. The data in Table VII indicate that the higher viscosity of the polymerics adversely affects their rates of recovery. In practical cord formulations where a balance of properties is needed, a blend of monomeric and polymeric types has been found effective.

Table VII

EFFECT OF PLASTICIZER VISCOSITY ON RECOVERY AT 23°C

| Sample Designation | Plasticizer Type | Viscosity* Poises, 25-30°C | Recovery Index (1/Rt) |
|---|---|---|---|
| 17-55 | Polyester "Z" | 4 | 92 |
| 7-58, 19-58 | Polyester "Y" | 14 | 73 |
| 14-55, 19-55 | Polyester "X" | 60 | 29 |
| 382-57 | Liquid Nitrile Rubber | 100 | 5 |

*Furnished by suppliers

★ ★ ★

**A** marked loss in elasticity occurs with decreasing temperature and in order to offset this, plasticizers should be chosen that have the flattest possible temperature response. Some idea of the magnitude of the changes which occur may be seen by referring to the −20°C data in Table VI. No attempt was made to obtain recovery data where the modulus exceeded 2500 psi as the helices were too stiff to be extended in the usual manner.

★ ★ ★

**An** effective way of improving elasticity is by increasing the percentage of plasticizer. The result of such variation on the recovery and the modulus of a series of compositions containing various percentages of a 1:1 blend of di-2-ethylhexyl phthalate and Polyester "Z" is shown in Figure 5. It is apparent that as stiffness decreased the samples became more elastic. The corresponding relationship between modulus and recovery for this plastic system is shown by the log-log plot of Figure 6, where the straight line obtained may be expressed by the equation:

$$(3)\quad G = 4000\ (1/R_t)^{-0.61}$$

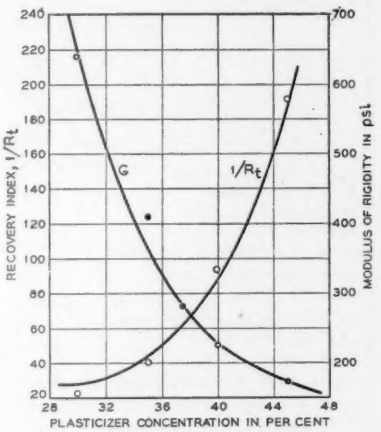



FIG. 5
EFFECT OF PLASTICIZER CONCENTRATION ON THE RECOVERY RATE AND MODULUS OF RIGIDITY

★ ★ ★

**Certain** other plasticizer systems might be expected to show similar relationships but the slopes and intercepts might differ. No univer-

(*Please turn to page* 1263)

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The Association functions along the following lines:

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2. The exchange of ideas on processes of production including machinery, technical processes, etc.
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## HADDON HALL HOTEL, ATLANTIC CITY, N. J., MONDAY THROUGH THURSDAY OCTOBER 13-16, 1958

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will be open each evening from Sunday, October 12th, except Wednesday night.
YOU ARE CORDIALLY INVITED TO CALL AND MEET OTHER WIRE INDUSTRY MEN

THERE WILL BE A REGISTRATION FEE OF $13.00 FOR MEMBERS AND $15.00 FOR NON-MEMBERS, INCLUDING AN ANNUAL LUNCHEON TICKET, FOR ALL THOSE ATTENDING THE TECHNICAL SESSIONS AND MEETINGS. PLEASE HAVE YOUR ASSOCIATION MEMBERSHIP CARD WITH YOU AND SHOW IT WHEN REGISTERING.

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REGISTRATION AND TECHNICAL MEETING ROOMS ARE ON THE 13TH FLOOR. Please be prompt in your arrival for the technical sessions. Those with rooms for entertainment are requested NOT TO KEEP THEM OPEN during the technical sessions.

### MONDAY, OCTOBER 13th

9:00 A.M.
REGISTRATION

10:00 A.M.
DIRECTORS' MEETING

12:30 P.M.
PROGRAM COMMITTEE LUNCHEON

# THE CONVENTION PROGRAM

MONDAY MORNING—

9:00 A.M. Registration Desk opens on the 13th Floor
10:00 A.M. Meeting of the Board of Directors of The Wire Association
12:30 P.M. Directors' Luncheon for Program Participants. Address of Welcome by President Tom M. Girdler, Jr.

MONDAY AFTERNOON—2:00 P.M.

## JOINT FERROUS AND NON-FERROUS TECHNICAL SESSION

Address of Welcome by Tom M. Girdler, Jr., President of The Wire Association

SYMPOSIUM ON ALUMINIZING

MODERATOR

C. C. Tappero, Wire Mill Superintendent
Colorado Fuel & Iron Corp., Pueblo, Colo.

| | |
|---|---|
| PAPER: "Aluminum Coating of Steel Wire" | by H. J. Godfrey, Asst. Chief Eng., Research & Development, John A. Roebling's Sons Corp., Trenton, N. J. |
| PAPER: "Batch Type Aluminum Coating of Small Steel Parts" | by Robert F. Joy, Eng., Development Research Department, Bethlehem Steel Co., Bethlehem, Pa. |
| PAPER: "Aluminum Coated Steel Wire Products" | by R. E. Griffiths, Asst. Dir. of Research, American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio |
| PAPER: "Alumoweld Wire" | by Leslie C. Whitney, Dir. of Res. & Devel., Copperweld Steel Co., Glassport, Pa. |
| PAPER: "Resistance to Corrosion of Aluminum Coated Steel Wire" | by E. T. Englehart and K. J. Brondyke, Alcoa Research Laboratories, New Kensington, Pa. |

TUESDAY MORNING—9:30 A.M.

## FERROUS TECHNICAL SESSION

MODERATOR

Charles H. Williams, Jr., Supt., Rod & Wire Mills
Pittsburgh Steel Co., Monessen, Pa.

| | |
|---|---|
| PAPER: "The Manufacture of Welded Wire Mesh and Some of Its Uses" | by Charles A. Kuhl, Metallurgist, Pittsburgh Steel Co., Monessen, Pa. |
| PAPER: "Mechanical Descaling of Wire Rod in England" | by H. F. Sanderson, Wire Mill Manager, Fredk. A. Power & Sons Ltd., Saltley, Birmingham, England |
| PAPER: "Lead Patenting of High Carbon Steel Rod and Wire" | by Rudolph H. Hertzog, Metallurgical Eng., Steel Wire Mills Div., John A. Roebling's Sons Corp., Trenton, N. J. |
| PAPER: "The New Galvanizing Line at Greenings" | by Richard Bliss, Unit Leader, Furnace & Associated Plant Equip. Sales, Industrial Heating Div., General Electric Co., Shelbyville, Ind.<br>and G. R. Armstrong, Chief Eng.<br>G. V. Globe, Supt., Wire Mill<br>The B. Greening Wire Co., Ltd., Hamilton, Ont., Canada. |

# THE CONVENTION PROGRAM

TUESDAY AFTERNOON—2:00 P.M.

## FERROUS TECHNICAL SESSION
## SYMPOSIUM ON SHOT BLAST CLEANING OF ROD

MODERATOR

Walter O. Everling, Director of Research
American Steel & Wire Div.
United States Steel Corp., Cleveland, Ohio

PAPER: "Descaling of Wires by Shot Blasting"
Part I —Introductory Remarks on Mechanical Descaling.
by Dr. Heinz Berge, Works Manager
Westfaelische Union A. G.
Hamm (Westf.), Germany

Part II—Recent Experiences in Shot Blasting Practice.
by Dr. Hans Krautmacher, Chf., Exper. Sta.
Westfaelische Union A. G.
Hamm (West.), Germany

PAPER: "Continuous Patenting, Cleaning and Coating of Rod."
by R. F. Warner, Wire Mill Mgr.
Leschen Wire Rope Div.
H. K. Porter Co., St. Louis, Mo.

PAPER: "Recent Experience with Shot Blast Cleaning of Rod"
by Kenneth J. Sorace, Chief Proj. Eng.
Lamson & Sessions Co.
Cleveland, Ohio.

PAPER: "Continuous Patenting, Cleaning and Coating of Rod."
by Donald K. White, Fore., No. 2 Wire Mill
John A. Roebling's Sons Corp.
Trenton, N. J.

WEDNESDAY MORNING—9:30 A.M.

## FERROUS TECHNICAL SESSION

MODERATOR

Stewart S. Gray, Asst. Vice President
Union Wire Rope Corp., Kansas City, Mo.

PAPER: "A Modern Order Entry and Invoicing System"
by T. W. Harman, Manager of Orders
and J. C. Farrell, Asst. Mgr. of Orders
Union Drawn Steel Div.
Republic Steel Corp., Massillon, Ohio

PAPER: "Engineering Report — Experimental Prestressed Concrete Highway" (Discussion and film)
by Carleton W. Garrett, Met. Eng.
Product & Development Div.
Jones & Laughlin Steel Corp.
Pittsburgh, Pa.

PAPER: "Spooling of Fine Wire"
by Raymond O. Hallberg, Genl. Supt.
and Fred A. Locke, Chief Process Eng.
Wilbur B. Driver Co., Newark, N. J.

PAPER: "Pressure Lubrication of Wire Drawing Dies—A Practical Application"
by Arthur V. Hedman, Die Room Foreman
Wickwire Spencer Steel Div.
The Colorado Fuel & Iron Corp.
Palmer, Mass.

## NON-FERROUS DIVISION PROGRAM

TUESDAY MORNING—9:30 A.M.

## JOINT NON-FERROUS TECHNICAL SESSION
## SYMPOSIUM ON ELECTRICAL TESTING

MODERATOR

Alexander A. Kerr, Supt. of Production
Electrical Wire and Cable Div.
John A. Roebling's Sons Corp., Trenton, N. J.

PANEL MEMBERS

W. J. Sievers, Supvr.
Wire & Cable Dept.
General Electric Co.
Bridgeport, Conn.

Gordon Bamber
Phillips Electrical Co., Ltd.
Brockville, Ont., Can.

Harry Slade, Res. Eng.
The Okonite Co.
Passaic, N. J.

John Heuther
Canada Wire & Cable Co. Ltd.
Toronto, Ont., Can.

J. K. Gillett
Entwistle Mfg. Co.
Providence, R. I.

D. H. Bodle
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

H. Peschel
Peschel Electronics, Inc.
Patterson, N. Y.

James L. Entwistle, Pres.
James L. Entwistle Co.
Cranston, R. I.

# THE CONVENTION PROGRAM

TUESDAY AFTERNOON—2:00 P.M. NON-FERROUS PROGRAM CONTINUED

## SYMPOSIUM ON HIGH SPEED DUAL TAKE-UPS

MODERATOR

Alexander A. Kerr, Supt. of Production
Electrical Wire and Cable Div.
John A. Roebling's Sons Corp., Trenton, N. J.

PANEL MEMBERS

Philip C. Greene, Sales Mgr.
Davis-Standard Div.
Franklin Research Corp.
Mystic, Conn.

O. Minardi, Chf. Eng.
Entwistle Manufacturing Co.
Providence, R. I.

B. J. Algar
General Engineering Co. (Radcliffe) Ltd.
Radcliffe, Lancs., England

Harry J. Bates
Reliance Electric & Engineering Co.
Cleveland, Ohio.

TUESDAY AFTERNOON—2:00 P.M.

## INSULATING MATERIALS

MODERATOR

James S. Higgins, Plant Eng., Copper Div.
Walker Brothers, Conshohocken, Pa.

PAPER: "Some Recent Applications of High Density Polyethylene" — by B. H. Krevsky
New Products Engineering Dept.
Bakelite Company
New York, N. Y.

PAPER: "Wire Insulation of 'Teflon'(R) FEP-Fluorocarbon Resin: Properties and Fabrication" — by Robert S. Lovett, Elec. Applications Technol. and Robert E. Stabler, Product Technologist
E. I. du Pont de Nemours & Co.
Wilmington, Del.

PAPER: "Preheating Conductors in Extrusion Insulating Processes by Copper Loss Method: Temperature is a Function of Current" — by J. W. Lechleider
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

PAPER: "The Thermal Embrittlement of Stressed Polyethylene" — by J. H. Heiss and V. L. Lanza
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

WEDNESDAY MORNING—9:30 A.M.

## POWER CABLES

MODERATOR

John C. Murray, Jr., Vice Pres.
Crescent Insulated Wire & Cable Co., Trenton, N. J.

PAPER: "The Performance of Vinyl Insulation Rated for 75°C THW Service" — by H. L. Wuerth, Mgr.
Wire & Cable Materials
B. F. Goodrich Chemical Co.
Cleveland, Ohio

PAPER: "Polyethylene for Overhead Line Wire" — by F. W. Wurtzell, Central Zone Mgr.
Bakelite Co., Chicago, Ill.

PAPER: "Polyethylene for Power Cables" — by M. M. Suba, Sales Mgr.
Extrusion Materials Div.
Bakelite Co., New York, N. Y.

PAPER: "Fabrication and Properties of 5005 Aluminum Alloy Conductors" — by Harold W. Adams, Prod. Director
Electrical Conductor Products
Reynolds Metals Co., Louisville, Ky.

WEDNESDAY MORNING—9:30 A.M.

## COMMUNICATION WIRES

MODERATOR

Marshall V. Yokelson, Research Metallurgist
General Cable Corp., Bayonne, N. J.

PAPER: "Plasticized Polyvinyl Chloride for Retractile Cords" — by J. B. DeCoste, J. B. Howard, V. T. Wallder and H. M. Zupko
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

# THE CONVENTION PROGRAM

WEDNESDAY MORNING—9:30 A.M.

COMMUNICATION WIRE SESSION CONTINUED

PAPER: "Inclined Enameling Machines for Coating Fine Gage Wires" — by Charles L. Erickson, Devel. Eng. and Grady Walker, Prodn. Eng. Western Electric Co. Buffalo, N. Y.

PAPER: "Accelerated Aging Tests in Service Performance of Neoprene Jacketed Drop Wire" — by A. P. Jahn and G. N. Vacca Bell Telephone Laboratories, Inc. Murray Hill, N. J.

WEDNESDAY AFTERNOON—1:00 P.M.

LADIES WELCOME — THE ANNUAL WIRE ASSOCIATION LUNCHEON — LADIES WELCOME

PRESENTATION OF AWARDS FOR 1957 PAPERS:

MEDAL AWARD (Ferrous Division): To Dartrey Lewis, Chief Eng., Research & Development, John A. Roebling's Sons Corp., Trenton, N. J., for his paper: "Combined Hot Rolling and Patenting of Rod."

MEDAL AWARD (Non-Ferrous Division): To Clement C. Lawson, Plant Facilities Engineer, Bell Telephone Laboratories, Inc., Murray Hill, N. J., for his paper: "Buried Distribution of Telephone Circuits."

CERTIFICATE OF HONORABLE MENTION (Ferrous Division): To E. Jefferson Crum, R. H. Miller Co., Homer, N. Y., for his paper: "The Coreless Coil—A New Wire Handling System."

CERTIFICATE OF HONORABLE MENTION (Non-Ferrous Division): To A. A. DeFoe, Chief Eng., Electrical Conductor Engineering Dept., Aluminum Laboratories Ltd., Kingston, Ont., Can., for his paper: "Oxide Coatings on Aluminum Wire."

PRESENTATION OF TWENTY-FIVE YEAR CERTIFICATES by Leslie C. Whitney, Chairman, Board of Past Presidents.

THE MORDICA MEMORIAL LECTURE by David Dwight Buchanan, Johnstown, Penna.: "What the Association Means to You—and What is Ahead."

WEDNESDAY AFTERNOON—4:00 P.M.

THE ANNUAL MEETING OF THE WIRE ASSOCIATION

This is the business meeting for Association members. Your personal attendance is desired and needed for the transaction of business.

WEDNESDAY EVENING

THE ANNUAL STAG SMOKER-DINNER

6:30 P.M.—Cocktail Bar Opens

7:30 P.M.—Dinner and Show

THURSDAY MORNING

PLANT INSPECTION TRIPS

Busses will leave the hotel at 8:30 A.M. for Roebling, N. J., for the Steel Wire Mills of John A. Roebling's Sons Corp., for the Ferrous Division Tour.

At the same time busses will leave also for Trenton, N. J., to visit Roebling's Electrical Wire and Cable Plants—of interest to the Non-Ferrous Division men.

Luncheon will be served at Roebling, N. J., for both Divisions.

Persons desiring to leave from Trenton after the tours, will be taken to the station and private cars may be used by those who have come to the Convention in them.

PLEASE WEAR YOUR BADGE ON THESE TOURS AND CARRY YOUR BUS TICKETS

Insofar as possible, all papers will be preprinted in the October issue of Wire and Wire Products. Others will be printed in November and December.

The Convention proceedings, the Story of the Convention and the Mordica Memorial Lecture will be published in the January, 1959, issue.

# THE MORDICA MEMORIAL LECTURE

An invitation to deliver the Mordica Memorial Lecture is considered the highest honor within the power of the Board of Directors of The Wire Association to bestow upon a member.

The lecturer is selected each year by the Board of Past Presidents on the basis of outstanding contributions to the wire industry.

The 1958 Lecture will be delivered by DAVID DWIGHT BUCHANAN, who retired in 1957 as Division Manager, Union Drawn Steel Division of Republic Steel Corporation after 54 years of service in the steel industry. His Lecture is entitled "WHAT THE ASSOCIATION MEANS TO YOU—AND WHAT IS AHEAD."

## THE ANNUAL MEDAL AWARDS

Every year a bronze Medal is presented to an author in each of the Association's divisions—Ferrous and Non-Ferrous—for those papers that come nearest to the requirements set forth herein. Honorable mention Certificates are also awarded. These awards are presented during the Annual Convention of The Wire Association. The medals and certificates are accompanied by cash awards of $100.00 and $50.00, respectively.

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Consideration for such awards is not limited to papers presented at Association meetings, but to all papers submitted by members as a contribution to The Wire Association and published in WIRE AND WIRE PRODUCTS.

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All papers submitted become the property of The Wire Association and are assigned to WIRE AND WIRE PRODUCTS for copyrighting and exclusive publication.

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Awards, you will note, are a recognition of a definite contribution to the advancement of the interests of the Wire Industry.

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Selection of papers for awards rests in the hands of the Association's Committee on Awards, which is headed by a director of The Wire Association.

### REQUIREMENTS FOR CONSIDERATION OF PAPERS

The first consideration of eligibility is that the author or authors must be Association members. A second is that it must be a contribution to the Association or to WIRE AND WIRE PRODUCTS, as articles for which the magazine has paid an honorarium cannot be considered. A third is that any paper that has been previously presented before another society or published in another magazine cannot be taken under advisement for awards.

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### JUDGING PAPERS

Papers eligible for awards are judged by the Oxford System, which is considered the best one so far devised for the impersonal determination of the worthwhileness of papers. Consideration is given to the following points, among others:

1. Value of the paper to The Wire Association's members as a whole.
2. Does it contain new information that has not been published hitherto, or is it merely a restatement of research material?
3. Does it constitute an advancement in knowledge by clarification of past information?
4. Does it provide a re-assessment of known facts in such manner as to be readily understood by the industry as a whole?
5. Are the claims in the paper factually supported with definite, impartial test data and established experience?
6. Is the paper valuable as a reference work?

All members of The Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association or the Regional Meetings.

## THE TWENTY-FIVE YEAR CERTIFICATES

These certificates of The Wire Association are being awarded by the Board of Directors at the Annual Convention of The Wire Association to those who have been members continuously for 25 years. These persons are:

H. M. BRIGHTMAN, Chief Eng.
Columbia Steel & Shafting Co.
Carnegie, Pa.

LEONARD C. CREWE, JR., Pres.
Maryland Fine & Specialty Wire Co.
Cockeysville, Md.

EDWARD J. P. FISHER, Wire Mill Consult.
Fisher Associates
New York, N. Y.

MOSS A. KENT, Management Consult.
White Plains, N. Y.

HARRY L. KITSELMAN, Vice Pres.
Indiana Steel & Wire Co.
Muncie, Ind.

JOHN RIGBY, Director
John Rigby & Sons Ltd.
Lowmoor, Bradford, England

RALPH B. ROTH, Vice Pres.
Ludlow Saylor Wire Cloth Co.
St. Louis, Mo.

# ELECTRIC WIRE & CABLE SECTION OF

## THE WIRE ASSOCIATION

The Association has been interested in and has had electric wire and cable men as members throughout its 29-year existence. During the period this membership has grown steadily and the service of the Association has developed correspondingly. It had reached a point where a special section to serve their interests became necessary and so this Section was organized in response to calls to fill the need for a common meeting-ground for production men.

The purpose of the Section is to disseminate the technical and practical information required for the production of Electric Wire and Cable. Men in the mills concerned with production problems, working with and through the Committee may now hold regional meetings devoted wholly to their interests and have programs during the Annual Convention concerned only with their problems.

The Committee began to function in 1958 and the full impact and value to the industry will become fully effective in 1959.

*The Committee*

**The Electric Wire and Cable Section Committee, comprised of eighteen members, is listed below:**

Clement C. Lawson (Chairman)
Plant Facilities Engineer
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

Harold W. Adams, Prod. Supvr.
Cable Div. Reynolds Metals Co.
2500 So. 3rd St.
Louisville 1, Ky.

David Barr, Plant Eng.
National Electric Products Corp.
338 14th Street
Ambridge, Pa.

Grover W. Brown, Mgr.
Machinery Development
The Okonite Co.
Passaic, N. J.

G. E. Forsberg, Vice-President
Surprenant Manufacturing Co.
172 Sterling St.
Clinton, Mass.

Charles M. Fredrickson, Tech. Director
Southern Electrical Corp.
P. O. Box 989, Chattanooga, Tenn.

James S. Higgins, Plant Eng.
Walker Brothers,
Conshohocken, Pa.

R. W. Higginbottom, Chief Cable Eng.
Triangle Conduit & Cable Co.
P. O. Box 711
New Brunswick, N. J.

Alexander A. Kerr, Supt.—Prodn.
Electrical Wire Div.
John A. Roebling's Sons Corp.
Trenton 2, N. J.

C. L. Kessler, Chf. Works Met.
Aluminum Company of America
Massena, N. Y.

Alfred H. MacGillivray, Supt.
Collyer Insulated Wire Co.
249 Roosevelt Ave.
Pawtucket, R. I.

Urbain J. H. Malo, Technical Dir.
The Crescent Co., Inc.
Front & Central Ave.
Pawtucket, R. I.

W. R. Moyers, Chief Eng.
Wire Engineering Dept.
Western Electric Co.
P. O. Station B
Buffalo 7, N. Y.

J. C. Murray, Jr., Vice-President
Crescent Insulated Wire & Cable Co.
319 N. Olden Ave.
Trenton 5, N. J.

D. M. Schmid, President
Techalloy Co., Inc.
Rahns, Pa.

Philip H. Snyder, Plant Mgr.
Wire and Cable Div.
The Electric Auto-Lite Co.
601 Poplar St.
Hazleton, Pa.

H. S. Spaulding, Tech. Supt.
Kaiser Aluminum & Chemical Corp.
P. O. Box 671, Newark, Ohio.

Roger T. Stafford, Project Engineer
Kennecott Wire & Cable Co.
Phillipsdale (Rumford 16), R. I.

Marshall V. Yokelson, Res. Met.
General Cable Corp.
Bayonne, N. J.

***Details concerning the activities of the Section will be reported as they develop.***

# THE WIRE ASSOCIATION

**RICHARD E. BROWN, *Executive Secretary***

**453 MAIN STREET** • **STAMFORD, CONN.**

# Spooling of Fine Wire

by

R. O. Hallberg
General Superintendent

and

F. A. Locke
Chief Process Engineer

Wilbur B. Driver Company
Newark, New Jersey

R. O. Hallberg

A paper prepared for presentation at the Annual Convention of The Wire Association on October 15, 1958 at Atlantic City, N. J.

Mr. Hallberg was born and raised in Mid-West. Prior to employment with W. B. Driver, was employed as mechanical engineer with Western Electric Company. Started with W. B. Driver Co. in 1933, advancing through Sales and Production Departments. Appointed General Superintendent in 1944 and to Board of Directors in 1957 as Secretary of Company.

Mr. Locke was born and raised in Pittsburgh, Pennsylvania. Graduated from Penn State University with B.S. in Metallurgy in 1936. Worked in Steel Industry (low carbon) to 1940. Crucible Steel Co. from 1940 to 1951 in Metallurgical and Production Departments. Assistant General Superintendent Braeburn Alloy Steel Company—1951. Metallurgical Editor — Industrial Heating Magazine 1952. Joined Wilbur B. Driver Company in 1953.

F. A. Locke

**Electrical** resistance alloys used in applications such as resistors, potentiometers, etc. are cold drawn to fine gauge wire as fine as ½ mil or .0005" diameter. This wire is supplied on No. 1 spools, which have a head diameter of 2-½", a traverse length of 3" and a barrel diameter of 1-¾". Since the finer gauges are difficult to draw, the amount of wire on a spool is somewhat dependent on size. However, a typical example for illustrating the spooling problem, would be a spool containing ¼ pound of .001" diameter wire.

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**This** would be a length of approximately 90,000 feet. Assuming the wire has an electrical resistance of 800 ohms per foot, the total electrical resistance would be approximately 72,000,000 ohms. If this wire is being used to wind meg-ohm (1 million ohms) resistors, approximately 1,250 feet of wire will be required per resistor (Figure 1).

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**For** each resistor, the first few feet of wire will be wound at a relatively slow speed, but the winding speed will be accelerated quickly to higher speeds, perhaps as fast as 1,000 feet per minute. When the resistor contains close to the desired length of wire, the winding speed will be decelerated quickly and stopped at the proper interval. It is readily apparent that this fine wire must be placed on the spool under closely controlled conditions in order to permit high-speed removal without breaking or snarling. The magnitude of the problem becomes even greater when one considers that a sudden pull or jerk causing a tension of a .15 pound would stretch the wire and spoil the electrical resistance. A tension of .2 pound would break the wire. This does not imply that the alloy is weak or soft. The wire actually has a tensile strength of 170-180,000 psi, but the cross-section is extremely small.

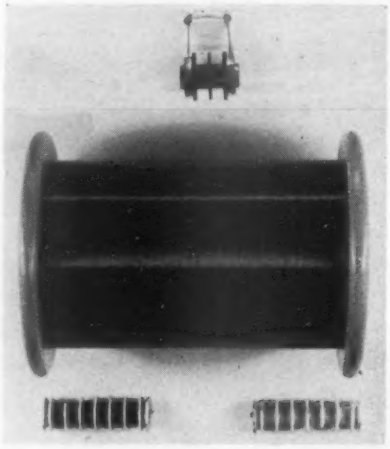

Fig. 1—A No. 1 plastic spool of fine gauge enameled wire and typical resistor bobbins.

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**There** are two generally accepted methods for removing fine wire from a spool at high speeds. The first method is called dereeling. In this case, the spool is mounted on a spindle or shaft and the spool revolves as the wire is pulled off. In order to minimize tension generated by friction, the spindle should be mounted in bearings. Also, the momentum, developed by the spool at high speeds, will cause the spool to "over-run" when the speed is decreased unless a quick acting brake is used.

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**The** other method for removing fine wire from a spool at high speeds is called ballooning. In this method the spool is set or mounted in a fixed position and the wire is ballooned or spiralled off over one end of the spool. Since the spool is stationary, there is no concern about bearings or spool momentum.

**In** order to simulate actual operating conditions for the removal of fine wire from a spool, a wire ballooning set-up similar to those used by resistor manufacturers was purchased. This equipment was used to investigate various factors such as tension and traverse rate which might affect the spooling of fine wire. The following equipment was used for the ballooning tests: (Figure 2)

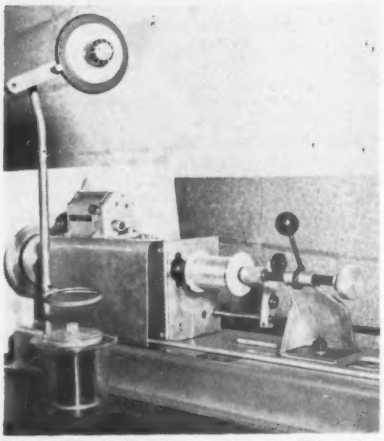

**Fig. 2—Wire ballooning equipment. This set-up was used to obtain tension measurements at various ballooning speeds.** * * * * *

**High Speed Spooling Machine:**
**Adjustable speeds up to 3,000 feet per minute.**

**Take-Off Stand:**
**For mounting spool and guiding wire.**

**Plastic Cup:**
**Spool is mounted in cup and placed on stand.**

**Nylon Whisker Ring:**
**Supplies some tension, prevents loose turns.**

**Plastic Cap:**
**Fits over head of metal spool to provide a smooth surface.**

**G. E. Hysteresis Tension Control:**
**Adjustable tension from 0 to 10 grams.**

**Tension Meters:**
**Measure from 0 to 250 grams.**

**Experimental Spools:**
**Fine wire, of various sizes, was spooled onto No. 1 spools under controlled conditions. Using constant speed and winding pitch (traverse rate), spools were produced using three different levels of winding tension. For example. with .001" Evanohm wire, a set of spools was produced at a low tension of 2-5 grams, a second set at 20-25 grams, and a third set at 30-35 grams.**

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**The** set-up of the above equipment, shown in Figure 3, was used to obtain data on ballooning wire from regular spools and on experimental spools produced for this investigation.

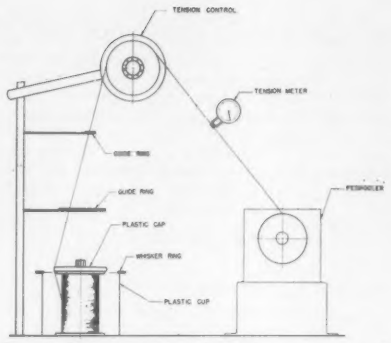


**Fig. 3—Sketch of wire ballooning set-up.** * *

## Test Results on Regular Spools

**The** initial test was to place the spool in a vertical position on the base of the take-off stand with no restrictions. The spooling machine was then run at slow speeds, maximum speed, and cycled from 1,000 feet per minute speed to stop and back up again. Speeds and take-off tensions were recorded throughout this test. All spools would withstand all of these operations without any wire breakage. This test demonstrated that uninhibited wire can be ballooned at high speeds with a resulting low tension.

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**The** second step was to place the spool in the plastic cup on the base of the take-off stand. The addition of the cup did not seem to impair the operation and all of the above cycles were repeated without wire breakage.

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**The** third step was to place the whisker ring on top of the plastic cup. This served to raise the resulting wire tension from 2 to 4 grams, depending upon the condition of the whiskers. Some breakage of the wire was experienced and the flexibility of the operation was reduced materially.

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**The** fourth step was to add the plastic cap to the top flange of the spool. This served to increase the tension approximately 50%. The maximum operating speed was reduced to 800-900 feet per minute. At this top speed the whisker ring and the plastic cap would vibrate and rotate and eventually cause the wire to break. The same actions occurred at certain critical low speeds. The flexibility of the cycling operation was reduced drastically. Figure 4 shows an average plot of the increase in tension as the various additions were made to the ballooning set-up.

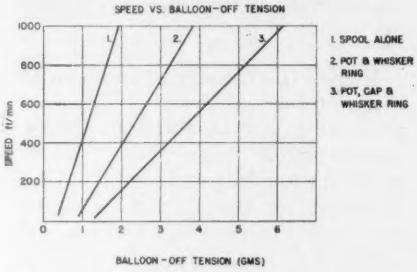


**Fig. 4—Curves showing increase in balloon-off tension as inhibiting devices were added to the ballooning set-up.** * * * * * * * *

**The** upper ¼" guide was lowered slowly to the level of the lower metal ring. This caused the whisker ring and plastic cap to vibrate violently and invariably cause wire breakage. Apparently any restriction which forces the wire to rub the edge of the plastic cap, will cause breakouts. This means that there is an optimum position for rings, guides, etc.

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**Experimental Spools:** Spools produced at the various tension levels were subjected to the same ballooning tests as outlined above. The following observations were made:

1. **Regardless of the tension used in winding, these spools showed the same general characteristics as above in that the wire ballooned off well, when uninhibited, and began to fail as the whisker ring and plastic cap were added to the set-up.**
2. **Low tension spools performed the poorest of the three groups. This group had the lowest maximum speed, the most vibration of cap and whisker ring, and the most breakouts when cycling from stop to maximum speed. This group of spools did not provide good flexibility in operation.**
3. **The medium tension and high tension groups of spools were vastly superior to the low tension group in that the maximum speed was much higher, little or no vibration of cap or whisker ring occurred during cycling, and few breakouts were experienced.**

## Winding Tension -VS- Balloon-Off Tension

**The** experimental spools, pre-

pared as described above, were used in a ballooning test to obtain data on balloon-off tension at various speeds -vs- original winding tension. These spools, wound at various tension levels, were ballooned at various speeds, using the plastic cup, whisker ring and plastic cap. Speed and balloon-off tension measurements were made.

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**Figure** 5 for .001" wire and Figure 6 for .0015" wire are typical plots of the data obtained. These curves show that there is an optimum winding tension required in preparing the spool to produce minimum balloon-off tension at speeds up to 1,000 feet per minute. If the spools are wound at very low tensions originally, or at relatively high tensions, the balloon-off tension is high.

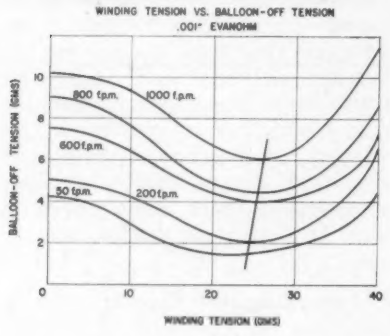



**Fig. 5—Curves developed at various speeds showing balloon-off tension developed from spools prepared at low, medium and high winding tensions. Optimum winding tension is shown by vertical line.** ° ° °

## ABSTRACTS

**These abstracts are published through the courtesy and with the permission of the Industrial Diamond Information Bureau, 2 Charterhouse Street, London , E.C.1, England. Inquiries regarding them should be directed to the Bureau.**

### DIAMOND DIES FOR WIRE DRAWING

British Standards Institute, London W 1. BS 2946; 1958, 12 pp. Price: 4s Od

**The standard covers both reinforced and non-reinforced diamond dies, and therefore supersedes BS 1168—Diamond dies for wire drawing (non-reinforced), and BS 1393—Diamond dies for wire drawing (reinforced). It specifies the quality of the diamond, the mounting, casing, size tolerance, and marking of diamond dies for wire drawing. Briefly, it specifies that the die stones should be clear of defects, eg inclusions and fissures, unless they are well outside the working zone; the profile of the bore is to be agreed between purchaser and manufacturer; tolerance on the bore diameter shall have an upper limit of the nominal diameter, or 0.00005 in. (0.001 mm), whichever is the greater, below the nominal diameter; mounting specifications are given for reinforced and non-reinforced dies; casings shall be of steel, brass or an alloy with a modulus of elasticity not less than 15 x $10^6$ lb/sq in; casing diameter of 1 ± 0.005 in., unless otherwise specified by the purchaser; the bore of the diamond shall be co-axial with the casing; the die shall be clearly marked with the manufacturer's trade mark or name, and serial number; size to be stamped on the entrance side of the die which shall be indicated by a concentric circular groove.**
**Nomenclature and methods of examining diamond dies are explained.**

### SOME EXPERIMENTAL INVESTIGATIONS ON WIRE-DRAWING

C. O. von Hofsten, E. Lindstrand. Jernkont Ann 1958 Vol 142 (3) pp 128-164 (In Swedish; abstr in English)

**Experiments were performed on a wire drawing machine for dry drawing, with a range of 90-1,000 ft/min. The investigation was principally concerned with the influence of different coatings on the drawing force and temperature. The optimum die angle and the properties of a rotating die were also studied. Temperature measurements proved to be a better method of assessing the effects of different coatings than was the measurement of drawing force. In drawing annealed wire of low and medium carbon content, the lowest temperatures were obtained when using a combination of sullcoat and borax. The optimum die angle proved to be about 14°. Rotation of the die appeared to have no influence on the drawing force as long as the speed of drawing-speed of rotation ratio was kept within reasonable limits. The only advantage of rotating dies that was confirmed was the fact that even oval dies were restored to round after being used for some time. 34 illustr.**

### SOUNDS OUT WIRE FLAWS

Anon. Prod Eng 1958 Vol 29 (24) pp 18-19 (June 16)

**Siemens & Halske, Bonn, use a new method of discovering physical discontinuities and defects in fine-gauge wire that goes into light bulbs and vacuum tubes. The fine gauge wire is power drawn across two wave guides at a steady rate, and ultrasonic waves cause vibrations to flow along it to a guide linked to a detector screen. If the pulse amplitude varies more than allowed by pre-set tolerances, the drive motor shuts down and, in some models of the test equipment, an audible signal sounds.**

### ON B. N. VORONTSOV, I. A. PANFILOV'S ARTICLE 'ALLOWANCES FOR WEAR OF THIN WIRES'

Anon. Izm Tekh 1958 (1) p 86 (Jan/Feb); Library of Congress Mthly List Russ Access 1958 Vol 11 (2) p 515 (May) (Original in Russian)

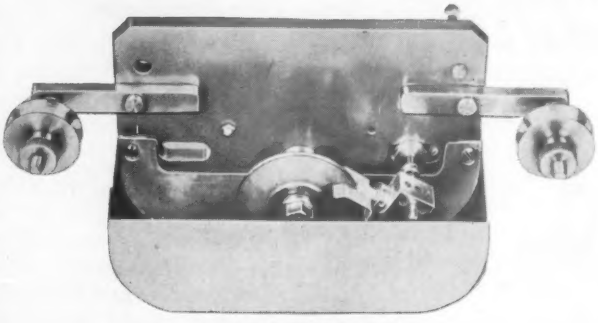
### WIRE-DRAWING — A SURVEY OF CURRENT LITERATURE

E. Lindstrand, Jernkont Ann 1958 Vol 142 (3) pp 105-127 (In Swedish)

### SURFACE-STRESS TESTER FOR DIAMONDS

Dr Heinrich Schneider, Bad Kreuznach, Germany. Ind. Diamond Rev 1958 Vol 18 (211) p 118 (June)

**A stress tester for checking diamonds for wire drawing dies is shown. The stones are mounted on a viewing stage and observed through a magnifying eyepiece. It operates on voltages of 220 AC or DC, but the voltage can be altered by a change of bulb. 1 illustr.**

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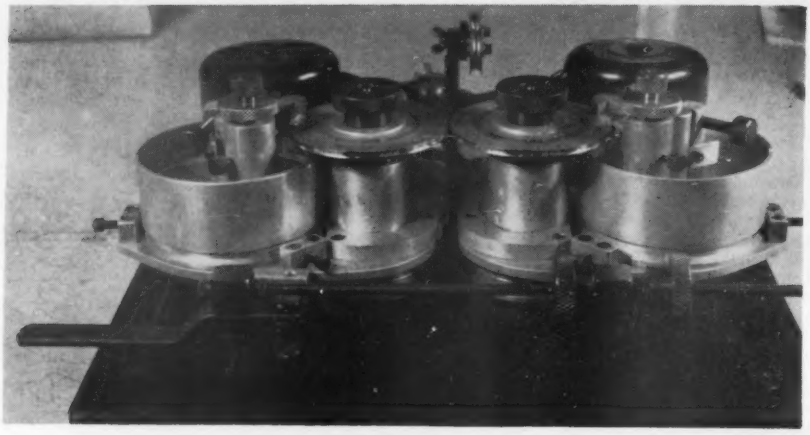
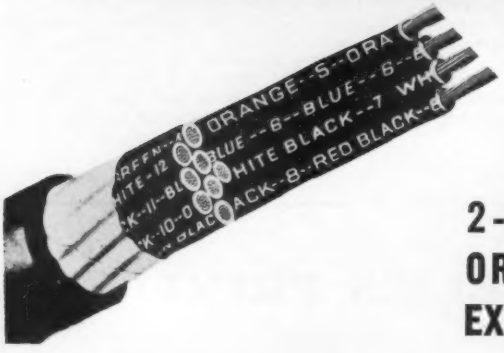
FOR
# ELECTRIC WIRE and CABLE





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**Full line of Photo-Engraved Marking Wheels, Machines and Inks for all electric wire marking for identification.**


## New Wiring Fastener for Use in Missiles and Aircraft

**"Viton"** synthetic rubber, Du-Pont's new fluorine-based elastomer which resists oils, fuels, and solvents at high temperature, has been adapted to a recently developed wiring fastener, making it useful for missiles and high-speed aircraft.

★ ★ ★

**The** fastener consists of a U-shaped nylon cradle and a flexible clip of "Viton" which cinches across the open end of the cradle and locks under inverted lips, holding a bundle of wires securely in place. Not only does this fastener provide a neater and more secure wire bundle than tape, string, or wire wrapping, but it can be installed in about half the time.

★ ★ ★

**Du Pont** makes only the "Viton" synthetic rubber and the "Zytel" nylon resin from which the cable fastener is fabricated. It is marketed as "Insuloid Cradle Clip System" (U. S. patent applied for) and is manufactured and sold in the United States and Canada by Electrovert Inc., 124 East 40th St., New York 17, N. Y.

★ ★ ★

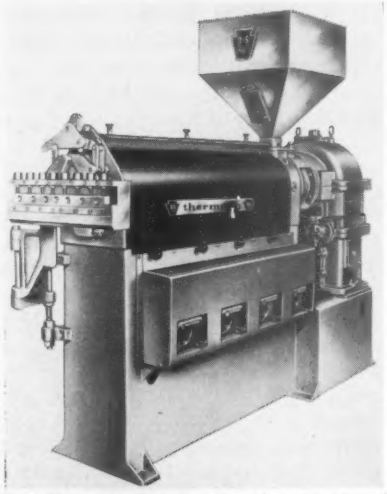
**The** fastener was designed originally with a clip of neoprene synthetic rubber. This combination of materials still is available and will give excellent service under most conditions. But with temperatures as high as 300 degrees F., accompanied by the presence of lubricants, aromatic fuels, hydraulic fluids, and other strong oxidizing agents, "Viton" is required for the clip material. "Viton" has the further advantage of being even more resistant than neoprene to ozone, sunlight, and weather. Four sizes are available to accommodate bundles of wire from ¼-inch to 2¼-inches in diameter. If an anchoring system is used, the cradles may be screwed to supporting members before fastening the wire bundles.

## New Extruders Announced

A complete new line of thermoplastic extruders will be exhibited at the S.P.I. Show in November by **Davis-Standard,** Division of **Franklin Research Corporation,** Mystic, Conn.

★ ★ ★

**The** new Thermatic Series extruders will be displayed for the first time at the Show. A complete 2-½" extruder will be exhibited in addition to a cut-away gear case which will permit visitors to closely inspect the internal



New Thermatic Extruder. * * * * *

operation of this vital driving unit. Also included in Davis-Standard's exhibit at booths 714 and 716 will be stock screws, heads and other accessory equipment.

★ ★ ★

**The** new D-S Thermatic Series extruder represents an entirely new design from top to bottom which permits higher production capacity in all bore sizes than previously possible. Featuring helical or herringbone gear sets specifically designed for extruder drives, each Thermatic model—2-½", 3½", 4-½", 6" and 8" bore sizes—can handle higher horsepower and therefore deliver higher screw speeds than former models. Thrust bearings and other load carrying components have been increased accordingly to give Thermatic Series extrud-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Built in the U.S.A. to machine-tool standards of **QUALITY.**

**ALL PARTS** for **ALL SIZES** always in stock.

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**TOOLING INTERCHANGEABLE** one machine to another of same size.

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**EASIEST** to tool and adjust.

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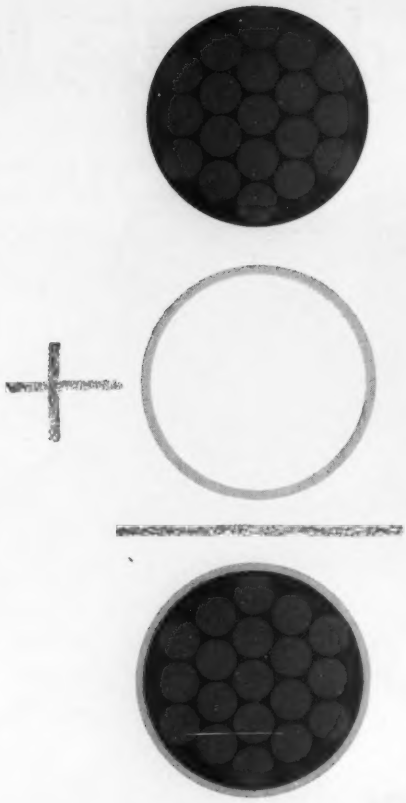
68A38



# Wire coating problem? Best solution: come to Lacquer Headquarters

*Specialists in formulating and producing lacquers* for the insulated wire industry, NELCO has analyzed and solved just about every conceivable application problem.

In more than 37 years, our research organization has developed countless special NELCO Lacquers. Each is designed to do a specific job, and do it supremely well.

Thus, you and your customers have the assurance that the lacquer coating is equal in quality and performance to your insulated wire and, like it, ready to meet the highest specifications.

*With the NELCO data book* in your file, you will have authoritative facts on a wide variety of finishes for wire and cable constructions. Write for it now, or send us information on your specific requirements.

NELCO

LACQUERS

**Chemical Products Corporation**

EAST PROVIDENCE, R. I.

ers the highest output capacities in the field.

★ ★ ★

**Literature** and data on the Thermatic Series will be available at the Davis-Standard booth or from the company.

## Produces "Custom-Clad" Materials

**Technical** specialists at Alloy Metal Wire Works, **Riverside-Alloy Metal Division, H. K. Porter Company, Inc.,** are producing "custom-clad" materials with unusual alloys as sheathing and core. The new materials have proved extremely valuable in applications subject to severe corrosive influences and requiring excellent mechanical and thermal properties.

★ ★ ★

**Basic** principles used to produce nickel-clad copper have been adapted specially to the new custom-clad materials. Unique combinations using Monel, nickel, Inconel, stainless steel and other special alloys have been produced. Conventional clad materials, including 27% and 64% nickel-clad copper in coiled wire, spooled wire and straightened and cut lengths from diameters varying from .375 to .003-inch fine wire, have been a specialty at Alloy for many years.

## Mylar for Insulation Lowered in Price

**The Du Pont Company** reduced the price of several types of "Mylar" polyester film in August. The action was made possible by increasing efficiencies in manufacturing. This is the fifth consecutive price reduction since the start of commercial production four years ago, and the second during the past year.

★ ★ ★

**Type** A "Mylar", 100 gauge through 1000 gauge, was reduced 20 cents per pound. This type has a wide variety of uses, including electrical insulation, magnetic tape, cartography and drafting materials, and protective and decorative laminations. Some other types were not reduced.

The current reductions bring the price of "Mylar" in the range of $1.80 to $3.90 a pound.

### National Electrical Week

Scheduled annually for the week of Thomas Alva Edison's birthday, the National Electrical Committee has set February 8-14, 1959, for the observance of this event.

★ ★ ★

The week is sponsored by major trade associations in the Electrical Industry to enhance public appreciation of electricity and the contributions of the industry to the Nation's progress and economy.

★ ★ ★

Full information may be secured from the Committee, which has its headquarters at 290 Madison Ave., New York 17, N. Y.

### NSC Meets in October

The National Safety Council has announced that its 46th congress will be held in Chicago on October 20-24.

★ ★ ★

300 sessions and 900 speakers are planned for the 5-day Congress, at which 12,500 persons are expected to attend. Details may be secured from the Council's headquarters at 425 N. Michigan Ave., Chicago 11, Ill.

### Swedish Steel Firm 100 Years Old

July 18, 1958, was the 100th anniversary of the steel industry in Sweden and of Sandvikens Jernverks Aktiebolag.

★ ★ ★

On that date 100 years ago G. F. Goransson pioneered the age of steel by the Bessemer process by producing the first ingot steel. From this the company evolved, the works at Sandviken now covering about 400 acres. The result was achieved through Anglo-Swedish co-operation and led to mass produced ingot steel.

### Three New Spoolers Announced

The Robert J. Emory Co., 31 E. Runyon St., Newark 5, N. J., producers of precision, layer winding spooling machines, has announced


*EFFICIENT, MODERN SYSTEMS*

*FOR*

*ELECTRICAL WIRE & CABLE MANUFACTURING*

• *CABLE LACQUERING SYSTEMS*

**Conventional cellulosic, or other type, lacquers are applied in successive continuous coats from one to twenty-eight coats over fibrous braid wrapped primary conductors. One end, four ends, or eight ends of wire are handled continuously. System includes letoff, application, drying and constant tension takeup equipment.**

• *WIRE ENAMELING SYSTEMS*

**Natural and synthetic enamels, silicones, solution nylon, modified plastisol, and similar insulating coatings are applied to bare, cotton or glass covered wire in round, square or rectangular cross section. Ten or twenty simultaneous strands are handled. Systems are complete with letoff, preannealer, application system, capstan and multiple takeup unit.**

• *ASBESTOS INSULATING SYSTEMS*

**Carded asbestos is applied to continuous single conductor as an integrated operation with saturating, rotary forming, drying, cooling and polishing of the finished wire. Wire from No. 20 gauge to No. 6 AWG is handled through an asbestos wall thickness range of from .008″ to .040″ thickness in a single pass.**

• *RUBBER OR PLASTIC JACKETING SYSTEMS*

**Rubber and thermoplastic jacketing compounds are continuously applied to electrical wire or cable by the extrusion method. High speed, constant tension letoff and takeup equipment, controlled cooling or continuous vulcanizing equipment are powered by synchronized range drives as complete, integrated wire handling systems. Extrusion machines of customer's choice are furnished.**

• *GLASS & VARNISH COATING SYSTEMS*

**Double layer of glass or cotton wrapping is applied to round, flat or square conductor. Two individual coatings of high temperature varnish are applied and the finish baked in a continuous operation. Units are complete from letoffs to takeup frames.**

• *SELF TRAVERSING REEL CORD DRYERS*

**These ingenious machines are used to remove hygroscopic moisture from fibers, braided or knitted flexible cable. These machines increase extrusion speeds, reduce blister scrap loss and improve diameter control. They are easily installed in existing extrusion line.**

*TECHNICAL INFORMATION ON ANY OF THESE PROCESSES UPON REQUEST*

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**SO BRIGHT**—Use *Brytite* wherever a shinier, brighter zinc coating is desired for long lasting, more sparkling product appearance. Eliminate polishing and special finishing operations

**SO TIGHT**—Brytite has remarkable forming qualities. The zinc coating is so tight it will withstand severe deformation of the base metal without flaking, powdering or peeling.

**SO CLEAN AND SMOOTH**—Satin smooth in looks and feel, BRYTITE immediately raises the quality appeal of your product. You get smoother production, too—the result of precise uniformity and quality controls.

**ROUND AND SPECIAL SHAPES**—*Brytite* is available in many sizes in round wire, and may on inquiry, be furnished in standard and special shapes—flat, half-round, oval, half-oval, square, rectangular, and many others.

a bright new wire with a brighter tighter finish

**Brytite**®

A PATENTED GALVANIZING PROCESS

**TEMPERS AND ANALYSES**—Specify BRYTITE in various tempers and analyses in the low carbon and medium low carbon steels.

**FINISHES**—Satin Finish, Unwiped (where a heavy weight of zinc coating is required) and Redrawn, in certain sizes.

no polishing...no buffing...no finishing...

withstands difficult forming operations

**CONTINENTAL STEEL**

**CORPORATION · KOKOMO, INDIANA**

PRODUCERS OF Manufacturer's Wire in many sizes, tempers and finishes, including Galvanized, KOKOTE, BRYTITE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, and special shaped wire. Also Welded Wire Reinforcing Fabric, Nails, Continental Chain Link Fence and other products.

three new machines that are pictured and described in a new folder.

★ ★ ★

**One** is the No. 1900 HVE spooler for round and flat wires, taking round wires of from .010″ to .080″ in diameter and accommodating spools having up to 16″ flange diameter.

★ ★ ★

**Another** is the No. 301 single spindle spooler, that takes wires of from .003″ to .030″ in diameter. It accommodates up to a 10″ flange diameter reel.

★ ★ ★

**The** third is the No. 901 tinning spooler for wires of .010″ to .080″ in diameter on 16 spindles. This can be made to handle any spools the customer uses.

★ ★ ★

**All** Emory Spooling machines are precision built and practically maintenance-free. Please write the company for a copy of the folder "Three New Spoolers by Emory".

## New Carbide Pricing Procedure Announced by Firth Sterling

**Firth Sterling Inc.**, announces that it has adopted a new pricing system on its tungsten carbide tips, tools, and inserts, effective September 15th. The new system adjusts the price of these items in line with current costs, resulting in lower prices on some and higher prices on others.

★ ★ ★

**Firth Sterling Inc.** released a new catalog, incorporating this new pricing system, to the trade on September 15th.

## Folder on Multi-Low-Range Universal Tester

**An** illustrated six-page folder, describing its multi-low-range universal tester has been released by **W. C. Dillon & Company, Inc.**, manufacturer of scientific testing instruments.

★ ★ ★

**The** brochure lists complete specifications and prices on the Dillon Low Range Universal Tester, a small, compact motorized labora-

tory instrument that quickly, accurately, and economically makes tests in tensile, compression, transverse and shear on any low-strength industrial material up to 300 pounds. Other Dillon high-capacity testers are available for the precision testing of materials up to 200,000 pounds p.s.i.

★ ★ ★

**The** standard Dillon Multi-Low Range Tester has a grip clearance of 14¾". However, models are available with openings of up to 36 inches. The instrument meets applicable Federal and ASTM specifications. A hand-wheel operated bench model is also available.

★ ★ ★

**For** further information, write W. C. Dillon & Co., Inc., 14620 Keswick St., Van Nuys, Calif.

## To Handle WEMCO Pumps in the West

**Wire Equipment Manufacturing Co.,** Trenton, N. J., has announced the appointment of Gladding, McBean & Co., 2901 Los Feliz Blvd., Los Angeles, to handle the sale of Wemco Molten Metal Pumps in the western part of the U. S.

★ ★ ★

**Wemco** pumps are used for the rapid transfer of zinc, lead, tin, etc., and for heat treating salts.

## Sheffield Installing New Rod Mill

**Work** was started on the installation of a new rod mill for the **Sheffield Steel Division** of **Armco Steel Corporation** in Kansas City, Mo.

★ ★ ★

**The** mill, being built by **The Rust Engineering Co.** of Pittsburgh, is said to be one of the fastest 10-inch rod mills in the world, with finishing speeds of 6000 feet per minute on wire rods and with a production rate of around 90 tons an hour on bars.

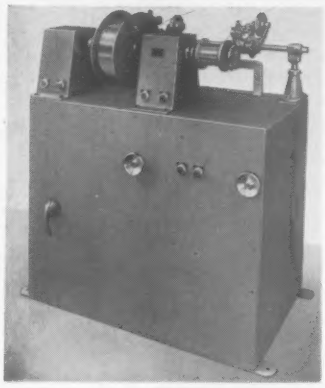
## Stainless Steel for Watch Springs

**Use** of Armco 17-7 PH stainless steel in Westclox watches is reported to eliminate rusting and breakage of mainsprings; also to insure more accurate timekeep-


# WIRE SPOOLING MACHINES

**for ALL MILL NEEDS for**

**HIGH PRECISION, DENSE, LAYER WINDING**



EMORY NO. 1900 HVE SPOOLER

Wire size range: .010" to .080" diam. and many flat sizes.

Max. spool size: 16" flange diam.

Capacity: 4 to 8 spindles.

Other sizes made to specification.

ADVANTAGES

- High production
- Labor saving
- Independent, rapid spool change
- Infinitely variable traverse lead
- Smooth acceleration
- Independent stop-start of individual spools
- Supplied ready for operation
- All models supplied in single and multiple spindles

EMORY NO. 301 SINGLE SPINDLE SPOOLER—PICTURED AT RIGHT

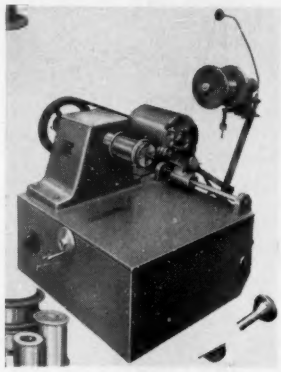
Wire size range: .003" to .030" diameter.

Max. spool size: 10" flange diameter.

Capacity: 1 spindle per unit.

ADVANTAGES

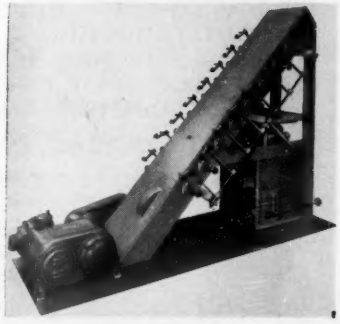
- Infinitely variable traverse lead
- Fully accessible controls
- Spool change easy and fast
- Dust protected
- Peak efficiency
- Supplied ready for power connection
- Adjustable pitch, traverse, speed



EMORY NO. 901 TINNING SPOOLER

At the right is shown a 16 spindle tinning spooler for spooling wire of from .010" to .080" diameters.

Each spindle is operated as an independent member, and the machine is built to the usual Emory standards of precision construction. Tinning spoolers are usually built to suit the spool the customer uses.



A FULL RANGE OF SPOOLING MACHINES ARE REGULARLY MADE, BUT MACHINES ARE ALSO BUILT TO SPECIFICATIONS. EMORY TRAVERSES MAY BE PURCHASED SEPARATELY, THESE HAVE ABSOLUTELY POSITIVE, CONSISTENT PINPOINT REVERSAL.

***Tell us of your spooling needs.***

**ROBERT J. EMORY COMPANY**

**31 EAST RUNYON STREET • NEWARK 8, NEW JERSEY**

***SPECIALISTS IN PRECISION SPOOLING MACHINE MANUFACTURE***

*for*

**WIRE *and* CABLE INSULATION**

**BLACAR®**

**CARY CHEMICALS, SPECIALIZING IN THE WIRE COVERING FIELD, OFFER TWO OUTSTANDING PVC COMPOUNDS — PROVIDING MAXIMUM PROCESSABILITY, FAST EXTRUSION AND UNIFORMLY HIGH QUALITY.**

If your needs are special—Cary can modify existing formulations or custom-formulate to the most exacting requirements.

**BLACAR® 2700:** UL-approved primary insulating material designed for low cost building wire applications—specifically: T, TW, TF, TFF, type wire (including oil exposure at 60°C).

Provides excellent processing features, high extrusion rates, good electrical properties, plus a smooth glossy finish. Ideal for use as a general-purpose material for a wide range of low-tension wires and cables.

**BLACAR® 2600:** UL-approved vinyl insulation material for type T, TF, and TFF wire and cable applications. BLACAR® Compounds are available in natural, white or black—in powder, diced or pellet form.

***Write for data, working samples or technical assistance.***

*Cary Chemicals Inc.*

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CARY CHEMICALS PRODUCTS:
- Vinyl Resins
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- Vinyl Plasticizers
- Sun Checking Waxes
- Gilsonite Compounds
- High Melting Point Synthetic Waxes

**Canadian Representative: Lewis Specialties, Ltd., 18 Westminster North, Montreal 28, Que.**


ing. A thinner mainspring is possible, which saves space and produces more parts per pound.

★ ★ ★

**Mechanical** properties and modulus of elasticity of 17-7 PH hard drawn wire and extra hard temper strip are said to be comparable with music wire and, for other applications, parts are much less affected by temperatures to 650 F than either 18-8 stainless or music wire.

## Electric Wire Trade Mark and Name Booklet Revised by NEMA

A compilation, originally produced in 1954, of trade marks and trade names of insulating materials and bare and insulated wire and cable used in the electric power field, has been revised and made available by the Wire and Cable Section, **National Electrical Manufacturers Association.**

★ ★ ★

**Listings** in the 10-page booklet are arranged by product classifications. The data was collected through a comprehensive survey in which more than 60 leading wire and cable manufacturers participated.

★ ★ ★

**Included** among the products covered are steel armored cable, building wire and cable, flexible cords, fixture and appliance wire and cord sets, asbestos insulated wire and cable, high temperature wire, magnet wire, paper power cable, portable molded rubber-sheathed cord and cable, rubber and thermoplastic power and control cable, service drop and service entrance cable, varnished cloth and weather-proof wire and cable.

★ ★ ★

**Copies** of the booklet may be obtained from headquarters of the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, New York, for 50 cents per copy.

## Sequoia Wire Buys Hall-Scott

**Sequoia Wire & Cable Co.,** has announced the acquisition of **Hall-Scott Electronics,** effective August 1st. The augmented Sequoia or-

ganization will operate the Hall-Scott facility in addition to its headquarters plant in Redwood City, according to **Burt Avery**, vice president and general manager.

★ ★ ★

**This** expansion of Sequoia, a division of Mandrel Industries, Inc., marks its entry into the production of cable assemblies and systems, with special emphasis in the missile and aircraft industries as well as other applications throughout the electronic industry, Mr. Avery said.

★ ★ ★

**Hall-Scott** Electronics has been one of the relatively few suppliers of missile-qualified cable assemblies, having participated in such programs as the Nike, Thor, Polaris, Bomarc and others.

## Copperweld to Install Alumoweld Equipment

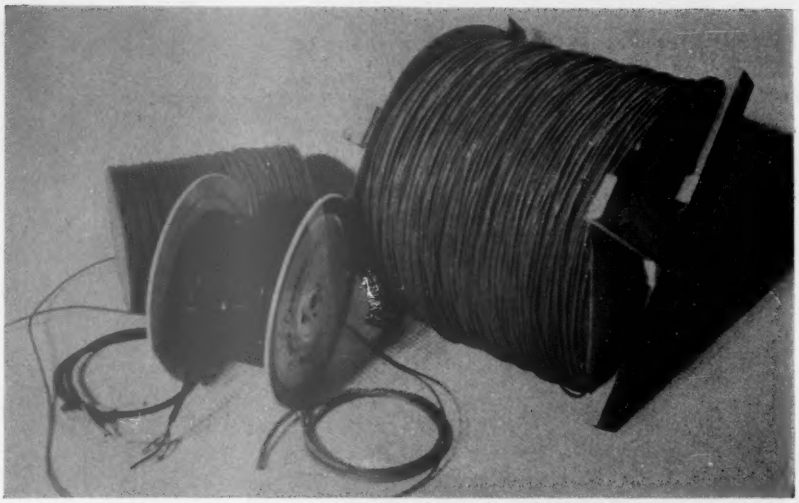
**Copperweld Steel Company** has approved an appropriation of $1,325,000 for installation of new plant facilities at Glassport, Pa., to meet a rising demand for its new Alumoweld wire and strand. "The favorable acceptance of Alumoweld has made this decision necessary," stated **William W. Ege,** Vice President in charge of the Wire and Cable Division.

★ ★ ★

**Limited** production of Alumoweld commenced a few months ago following several years of extensive research and development. Alumoweld is unique because it represents the only successful application of a thick cladding of aluminum to steel by an "atomic" weld. The process utilizes heat and pressure to weld the aluminum to the steel, which is drawn into wire. The new product is composed of 25% aluminum by area as compared to much smaller percentages for aluminum covered steel wire made by other methods.

★ ★ ★

**Better** corrosion resistance and conductivity, lighter weight, and permanent high strength are Alumolweld's advantages. Because of these qualities it is ideal for

For High Tensile Strength, Specify

# TEXTILENE GLASCOR*

**Soft, dry fillers for portable and flexible cords,** Textilene Glascor and Twi-Port have wide acceptance. Fiberglas-centered Glascor is exceptionally strong without added bulk or sacrifice of pliability. It goes into S, SJ, and SV cords with 18, 16, and 14 gauge conductors — Twi-Port into S and SJ cords with 12 gauge and larger conductors. Successful applications include control, appliance, and power cables; telephone drop wire; communications and coaxial cables.

**Twitchell's superior Textilene line** also includes: Fungus-resistant filler — *Twi-Tar.* Used for buried communications cable, expanded ACSR cable, and in other applications.

Moisture-resistant fillers—*Twi-Flex* and *Twi-Wax.* Used for non-metallic sheathed cable, maritime shipboard cable, varnished cambric cable.

*Patent No. 2832190

**For Every Wire and Cable Application**
**Twitchell's TEXTILENE Fillers Fill The Bill**

**Quality-controlled materials** that are dependably uniform . . . in standard forms, or customized to special needs.

**Initial low cost** with savings added by production efficiency . . . flexible, ready-to-use fillers that fit all equipment, handle and form easily, always maintain desired shape.

**Assured supply** from a reliable domestic source . . . always available in economical and convenient packaging.

**Proved performance** as components of cables and wires that meet government specifications . . . stability shown by trouble-free installations in continuous service 20 years and longer.

**FREE** — SAMPLE SPOOLS of any type of Textilene filler to demonstrate the superiority of Twitchell materials in your operation—also technical counsel without cost or obligation. Just tell Twitchell your end-use requirements. *Write, wire, or phone today:*

**E.W. TWITCHELL INC.**

**Third and Somerset Streets, Philadelphia 33, Pa. • REgent 9-7800**

PAPER PRODUCTS FOR THE WIRE INDUSTRY

Twisted • Folded • Pressed • Crushed • Shaped • Braided • Woven

TOTELINE
FIBER GLASS SPOOLS
never need maintenance
You'll never find light-weight molded fiberglass Toteline spools in your repair shops because they never need maintenance. They don't splinter, crack, dent or bend out of shape.
LOWEST NET COST
Toteline spools last a lifetime—making the cost per spool-year only a few pennies. They are lightweight, too—reducing handling expenses.
PRECISE WINDS EVERY TIME
The smooth, splinter-free surface of Toteline bobbins eliminates tangles or breaks. Wire coating remains undamaged and stays color-fast.
It will pay you to investigate using Toteline fiberglass reels in your operation. The savings in dollars and efficiency will surprise you. Why not write for more information now.
TOTELINE
MOLDED FIBER GLASS TRAY CO., Linesville, Pa.
World's largest producers of reinforced plastic trays and toteboxes

power conductors, overhead ground wires, core wires in ACSR and for guy and messenger strand.

### Elgin Abrasives Division Names Florida Representative

**The** Abrasives Division of the **Elgin National Watch Company** announces the appointment of **J. K. Kessler & Associates,** who will act as a manufacturer's agent for the division, handling sales of diamond compounds, diamond grinding wheels, carbide rotary tools, diamond powders, diamond saws, and Elgiloy spring materials.

★ ★ ★

**The** entire state of Florida will be served by the firm, working out of offices at 3313 West Sevilla Circle, Tampa 9, and 19441 N. E. 1st Court, Miami, it was announced by **William H. Baudouine,** Abrasives Division Sales Manager.

### Sheet and Tube Installs Communication System

**To** expedite entry, scheduling and shipment of product orders, The **Youngstown Sheet and Tube Company** has announced the enlargement of its General Sales and Order departments in the recently occupied new general office building in Youngstown.

★ ★ ★

**Along** with the added force, a modernized and enlarged wire communication center has been established in the home office.

★ ★ ★

**More** teletype equipment has been installed in the Youngstown and Indiana Harbor Mill production planning centers at East Chicago, Indiana. The new system and facilities puts orders for Youngstown products on the mills in both producing districts faster than before.

★ ★ ★

**Response** to customer inquiries is further expedited by the streamlined wire communication network linking the General office and Youngstown's 28 district sales offices.

## To Wind Association Clock

**Harold W. Rigby,** of John Rigby & Sons Ltd., England, who will be in attendance at the Annual Convention of The Wire Association in Atlantic City, has graciously consented to come to the Association's headquarters in Stamford, Connecticut, to wind the clock for the 1958-1959 year.

★ ★ ★

**The** clock, a stately and handsome instrument, was presented to the Association by John Rigby in 1948 on behalf of our English members and since that time has been wound each year by some one from England just before or following an Annual Convention. It is a 400-day clock.

## Wire Products Available in New High-Lustre Colors

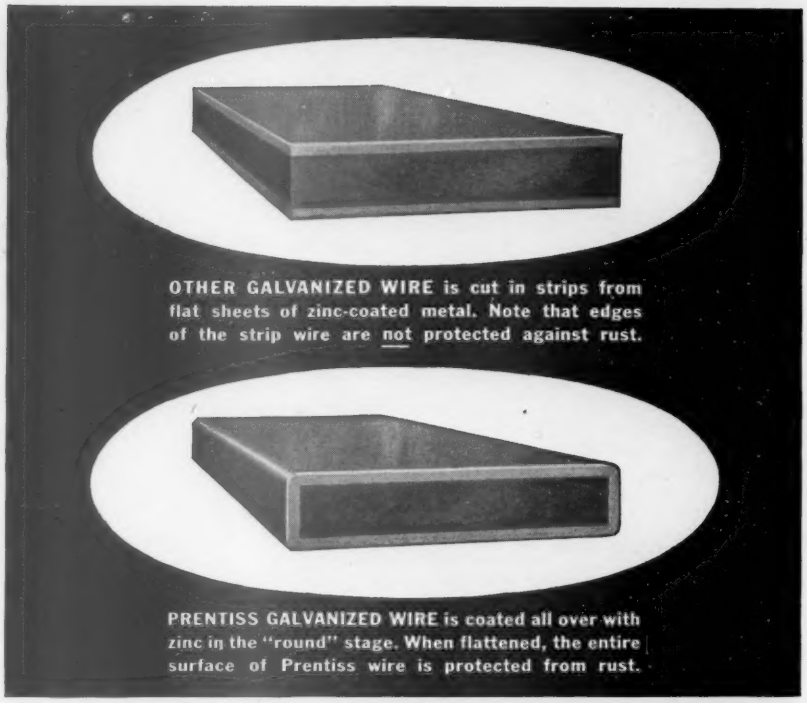
**E. H. Titchener and Company,** manufacturers of wire parts and welded wire assemblies, announces its zinc plating facilities are now capable of producing a low-cost, high-brilliance, corrosion-resistant zinc plating in various colors. Three colors immediately available are simulated brass (gold), simulated copper (pink), and ice blue.

★ ★ ★

**The** colored platings are of particular interest to manufacturers in the radio, television, and appliance fields where fan guards, wire motor mounts, decorative grills and other wire components must be designed with emphasis on attractive product appearance. The new color platings also offer an economical means of providing color identification for ease of assembly operations involving several metal components. Use of the new in-process colors can also eliminate spray painting otherwise required on such items as fan guards. The simulated brass and copper zinc chromate platings are less expensive than actual brass or copper platings, and the process is free from the "spotting out" sometimes encountered with these latter metals.

★ ★ ★

**Other** platings available are: olive drab zinc chromate, black

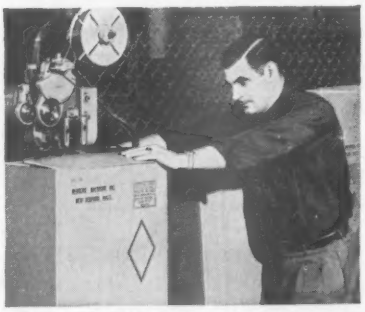


OTHER GALVANIZED WIRE is cut in strips from flat sheets of zinc-coated metal. Note that edges of the strip wire are not protected against rust.
PRENTISS GALVANIZED WIRE is coated all over with zinc in the "round" stage. When flattened, the entire surface of Prentiss wire is protected from rust.

# GET ALL-AROUND RUST PROTECTION with New Galvanized Wire From Prentiss

Where a high resistance to rust is needed, use new Prentiss galvanized wire. This new box-stitching wire is coated all over with zinc while still in the "round" stage, so that the entire surface—edges as well as sides—will be completely rust-proof. (See diagram above.)

When the wire is flattened, its corners remain rounded. It won't tear or scratch as ordinary "strip" galvanized wire does.

This zinc-coated *completely rust-protected* wire has passed a series of exhaustive tests and experiments in order to meet the high standards of Prentiss.



Prentiss galvanized wire gives completely rust-resistant closures.

Now, users of coppered, tinned, and galvanized wire can make all of their wire purchases at one source—PRENTISS. For additional information, and for the name of your nearest Prentiss Wire representative, write, wire, or call: *Prentiss Wire Mills, Riverside-Alloy Metal Division, H. K. Porter Company, Inc., Holyoke, Mass.*

**H. K. PORTER COMPANY, INC.**
RIVERSIDE-ALLOY METAL DIVISION

...Why? Because NYECO REELS:

- Are lighter—they lower freight costs.
- Outlast 12 wooden reels—require little or no maintenance.
- Are rugged, weatherproof and splinter proof.
- Warp-proof construction protects costly cable from handling damage.
- Protect your reputation—They insure your cable's safe arrival.

* These leading mills are just a few of the many that use NYECO Steel Reels: ANACONDA, GENERAL CABLE, OKONITE, PHELPS DODGE, ROEBLING, WESTERN ELECTRIC

- *ANY QUANTITY*
- *ANY SIZE*
- *ANY LOAD*
- *FLANGE DIAMETER From 36" UP*

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Specialists to the Wire Industries for Over 45 Years

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TELEPHONE: WHitehall 4-5380 CABLE: NYECO, N. Y. PLANTS: YONKERS, N. Y.


zinc chromate, brass, cadmium, nickel, chrome, Plastisol (black and white), plus barrel deburring and polishing, and electro-polishing of stainless steel.

★ ★ ★

**For** further information and free welded wire samples with new color-zinc plating, write E. H. Titchener and Company, 67 Clinton Street, Binghamton, New York.

## Spring Wires by Page

**A** special grade of mechanical spring wire—Page "Special HB"—manufactured to extremely close tolerances, is featured in an information-packed folder DH-107A, which has been released by the **Page Steel and Wire Division, American Chain & Cable Company, Inc.**, Monessen, Pa.

★ ★ ★

**The** "Special HB" grade, dry drawn to approximately music wire tensile strengths, can save users as much as 60% in costs. Tensile strength, chemical composition, range of diameters, dimensions, finish, packing, marking and minimum production quantities are listed for this grade of wire.

★ ★ ★

**The** folder also contains information about other grades of mechanical spring and upholstery spring wire. Grade, condition and tensile strength range in p.s.i. for both soft processed and hard drawn Mechanical Spring Wires are given. In addition, the gages and tensile strength properties of the various grades of IXL Upholstery Spring Wires have been prepared in a handy chart form.

## Heater for Extrusion Dies

**A** new Die Heater for aluminum extrusion dies is now available from **The Carl Mayer Corp.**, 20800 Center Ridge Road, Cleveland 16, Ohio.

★ ★ ★

**According** to the manufacturer, the Die Heater incorporates design features that will add years of efficient life and give closer temperature control than previous units used for this purpose.

★ ★ ★

**The** new Die Heater is completely refactory lined, the work chamber is 24 x 24 x 18 inches deep and temperature range is from 400° to 1000°F.

★ ★ ★

**This** unit is shipped completely assembled and ready to operate with either gas, electric or oil fired burners. Overall size is 41 x 41 x 46 inches high. Other sizes available.

### New 2-Conductor Rip-Cord Type Miniature Cable

A new 250 deg. C. miniature 2-conductor rip-cord cable, unique in the wire and cable industry, was just announced by **Tensolite Insulated Wire Co., Inc.,** Tarrytown, N. Y. Having an easy-to-strip outer binding of transparent "Teflon" tape, the new cable answers the electronic industry's needs for flat, compact, flexible two-conductor cable. The cable is available in conductor gauge sizes from AWG 20 to AWG 32 that meet military and commercial specifications.

★ ★ ★

**Designed** and developed originally for strain gauge applications for a jet engine manufacturer, the cable provides easy, low-cost wiring of intricate chassis and space, weight, and cost savings in the instrument field and other applications.

★ ★ ★

**Individual** wires of the cable are of Flexolon wire construction. Approximately eight layers of special "Teflon" tape insulation are applied longitudinally so that the wire performs in a manner superior to wires of other constructions. Greater flexibility, increased dielectric strength, higher average concentricity, longer lengths and greater miniaturization of Flexolon wire are achieved.

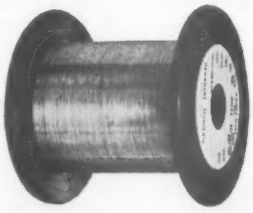
★ ★ ★

**Easy-to-strip** outer binding of special transparent "Teflon" tape permits easy color-code identification of the two conductors.

★ ★ ★

**According** to Tensolite's engineers, this rip-cord type cable will permit even greater miniaturization in the electronics field.

## How Lestershire Bobbins save money for Wire Manufacturer and its customers



Because they take rough handling in shipment, are re-usable and weigh far less than metal bobbins, Lestershire Wire Bobbins cut costs and losses for both a magnetic wire manufacturer and its customers.

**Withstand rough treatment.** Extra dense Vulcanized Fibre bobbin heads prevent damage to wire or bobbins in transit. Where brittle, metal-bound wood heads chip easily, shock-absorbing Vulcanized Fibre heads resist chipping and denting. In fact, Vulcanized Fibre has *self-healing* properties; bumps "iron themselves out" to the original, smooth, hard finish.

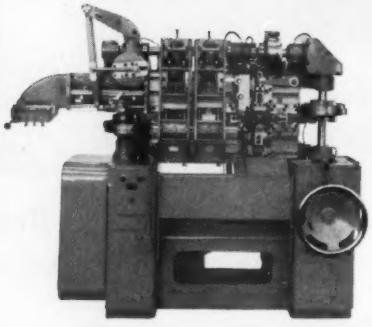
**Last indefinitely.** Lestershire patented anchor screw construction gives extra ruggedness to the head-barrel joint. Added strength in materials and construction means that Lestershire Wire Bobbins wear indefinitely. You can use them over and over again—and save the cost of frequent replacements.

**Save shipping charges.** Vulcanized Fibre weighs less than half as much as aluminum. The light weight of Lestershire Bobbins means big savings in shipping.

**Send for free details.** For full information on the Lestershire Line of Wire Bobbins, get our 12-page comprehensive Bobbin Manual. Write for your free copy direct to: Dept. GG—10.

LESTERSHIRE SPOOL DIVISION
NATIONAL VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE • *In Canada:* NATIONAL FIBRE COMPANY OF CANADA, LTD., Toronto 3, Ontario

THE FIRST ENTIRELY NEW FOUR-SLIDE IN FIFTY YEARS!



*A development of industry-wide importance is the Torrington Verti-Slide—a new vertical 4-slide that is the first major innovation in the basic field of wire and strip forming equipment in half a century!*

*The Verti-Slide was designed to meet a serious need for greater versatility, lower tooling cost, faster set-up time and reduced floor space. We urge you to investigate the new Torrington Verti-Slide in detail.*

**THE TORRINGTON MANUFACTURING COMPANY**

TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

## Book on Roller Chains

**The** most comprehensive treatise written on Precision Steel Roller Chains and Sprockets, Book 2657, is available from **Link-Belt Company.** It contains 154 pages of detailed engineering data illustrating roller chain's versatility and applications.

★ ★ ★

**Written** to serve as a practical textbook on the use of roller chain for both power transmission and conveyor service, the book contains typical installation conditions, formulas, charts and diagrams to simplify selection of proper chains for any application.

★ ★ ★

A copy of Book 2657, "Link-Belt Precision Steel Roller Chains and Sprockets," can be obtained without charge by writing to Link-Belt Company, Dept. PR, Prudential Plaza, Chicago 1, Illinois.

## Plastic-Clad Insect Screening

**New York Wire Cloth Company's** new "Vinalume" insect screening, introduced at the National Hardware Show, combines the wearing quality of aluminum with the corrosion protection of vinyl plastic. It is particularly desirable for homes near the seashore where salt-air corrosion of metal screening is a serious problem. Tests conducted by an independent testing laboratory revealed a life expectancy "in excess of any other screening previously tested."

★ ★ ★

**The** vinyl cladding is applied to the aluminum core wire by a patented process before weaving, which is done in the usual manner. The plastic is transparent and does not change the aluminum color, but tinted plastic coatings can be supplied on quantity orders.

★ ★ ★

**Screening** is woven in standard 18 by 14 mesh of 0.013-inch wire. Available in 100-foot or mill-length rolls in standard widths. New York Wire Cloth Company, 441 E. Market Street, York, Pa.

### Bulletin on Selection of Drives

**Fenn Manufacturing Co.,** 1 Fenn Rd., Newington, Conn., makers of swaging, rolling, wire and tube drawing machines, has issued a bulletin on "Selection of Drives for Rolling Mills."

★ ★ ★

**The** text contains information on AC, DC, single speed, variable speed, constant torque and constant HP as factors to be considered in selecting a drive suitable for a particular operating condition.

★ ★ ★

**Copies** of the bulletin will be mailed upon request to interested persons.

### New Wire Forming Machines Announced

**Worcester Automatic Machine Co.,** 91 Webster St., Worcester, Mass., has recently introduced some new wire forming machines, believed not to be types available from other sources.

★ ★ ★

**One** is a machine for producing heavy, flat helical chain links for endless chains. It handles 3/16" wire, but a machine for ¼" wire, has been designed.

★ ★ ★

**Another** is a machine for forming torsion spring rods for auto trunks and hoods. It is completely automatic and makes 16-20 rods per minute.

★ ★ ★

**Other** machines are being planned. These will not take the place of the universal four-slide machines, but are intended to make wire forms not adapted to the four-slide.

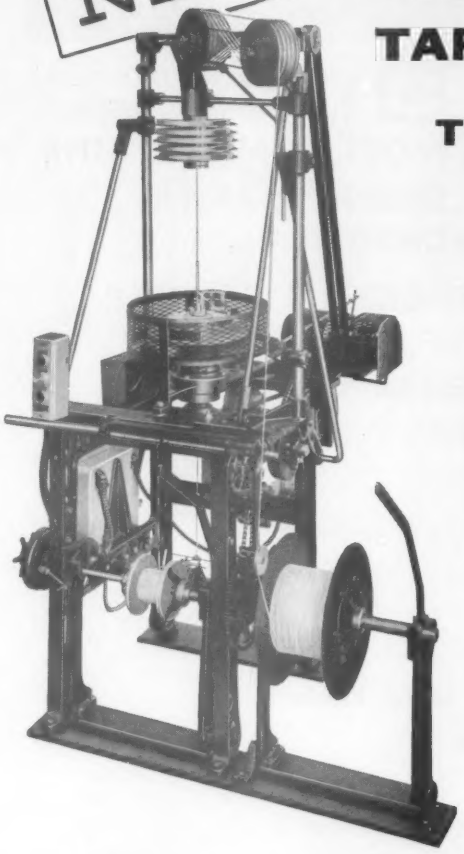
★ ★ ★

**The** company is headed by **Robert R. St. John,** President, and **Clayton F. Fisher,** Spencer, Mass., who was connected with the wire and spring forming industry for 42 years is serving as the company's consultant. Its facilities include, besides adequate manufacturing equipment, a modern engineering office and a research department.


NEW **WARDWELLIAN®**

**TAPE SERVER**

**TYPE N.T.T.**



*for Teflon, vinyl, and many other types of tape within specification range.*

- Serving head speed adjustable from 375 RPM to 1200 RPM, dependent upon character of material.
- Maximum diameter of flexible conductor ¼".
- Takeup adjustable for any desired lay with tapes up to ½" maximum width.
- Supply package 7" maximum diameter, 3" hole.
- Rate of production dependent upon width of material and angle of lay.
- Machine equipped with "Varidrive" motor.
- Machine operation fully electrically controlled.
- Serving head mounted on heavy duty ball bearings.
- Serving head can be operated clockwise or counter-clockwise.
- Machine equipped with new type multi-groove takeup sheaves and idler pulleys insuring a uniform product.
- Improved wire payoff tension control.
- Counter furnished for measuring product in feet.
- Light windup for winding small conductors on small reels; also adapted for reels of 30" diameter and 13" overall width.

*Complete information available on request.*

276-8

**WARDWELL**
BRAIDING MACHINE CO.

1212 HIGH STREET
CENTRAL FALLS
RHODE ISLAND, U. S. A.

*Representatives for Europe, British Colonies and Dependencies*
JAMES MACKIE & SONS, LTD., BELFAST, IRELAND

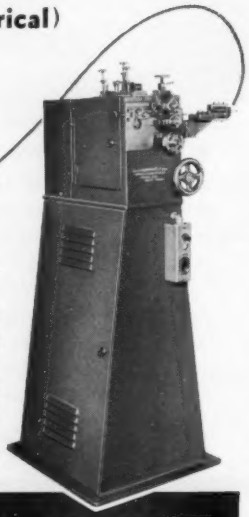
**THE MOST COMPLETE LINE OF SPRING MAKING MACHINERY . . .**

**DESIGNED AND BUILT FOR THE METAL WORKING INDUSTRY**

Sleeper & Hartley produce a complete line of spring-making machinery serving the basic metal working industries:

- Fabricated Metal Products
- Instruments
- Ordnance
- Furniture and Fixtures
- Transportation Equipment
- Electrical Machinery
- Machinery (except electrical)
- Miscellaneous Products

Quality and dependable service during 47 years of Sleeper & Hartley production have given the customer satisfaction for which we constantly strive.



**No. 0 UNIVERSAL SPRING COILER, ESCAPEMENT TYPE. Series 720 — 73" Model.**
This newest, versatile machine in the exclusive S&H escapement line incorporates the most advanced design engineering in the field, to give greater wire feed range and high speed production. Its many features include extremely accurate wire feed and controls for fine precision adjustment. Inertia is minimized since the only thing that starts and stops with this type feed mechanism is the wire itself.

*Write for latest information . . .*

SLEEPER & HARTLEY, INC., BOX 1249, WORCESTER 1, MASS., U.S.A.


## Tentative Guide for Fatigue Testing and the Statistical Analysis of Fatigue Data

**The** development of this guide has covered a period of over six years. While it is designed essentially for workers in the field of fatigue, it is believed that the concepts are of importance to designers, engineers, and students preparing for engineering careers. This guide describes some statistical treatments that are suitable for the analysis of fatigue data obtained by acceptable test methods. It further presents statistical treatments in forms useful to the test engineer.

★ ★ ★

**It** includes definitions of certain statistical terms, but only enough of the basic concepts of statistics to make the methods understandable. This guide covers the principal test procedures and techniques for analyzing the data. Included are: purposes of fatigue tests; definitions of test procedures; selection of test specimens and analysis of fatigue data. There are an index and extensive references.

★ ★ ★

**Copies** of this book may be obtained from ASTM Headquarters, 1916 Race St., Phila. 3, Pa. at $3.75 ea.

## Iron and Steel Dictionary

A 272 page dictionary containing over 7000 technical terms has been published by Stahl und Eisen, P. O. Box 2590, Dusselford (22a), Germany.

★ ★ ★

**This** is a German-English/English-German dictionary. In other words, the equivalent of any term in one language will be given in the other. Besides technical terms many important business terms are included. A great many conversion tables comprise a 20 page appendix in the back.

★ ★ ★

**Compiled** with the cooperation of the Iron and Steel Institute in London, the book is distributed by H. K. Lewis & Co. Ltd., 136 Gower

St., London W. C. 1. Copies are sold abroad for £1.1 net plus 1s. 4d. each.

## Copper Coated Welding Wire

**Specially** designed, alloyed and processed to weld the AISI-1025 to AISI-1045 steels, this formulation which is designated as Page A-S-18 Copper Coated Welding Wire has been introduced to the trade and industry by the **Page Steel & Wire Division, American Chain & Cable Company, Inc.,** Monessen, Pa.

★ ★ ★

**When** utilized with carbon dioxide gas welding processes or with a neutral flux submerged arc procedure on .35 carbon steel joints, the welding wire imparts a tensile strength of 75/81,000 p.s.i., a yield strength of 55/61,000 p.s.i. and an elongation of 24 per cent. Over 100 tons of the wire have already been used on very exacting .35 carbon steel jobs with perfect satisfaction.

★ ★ ★

**According** to the manufacturer, the A-S-18 wire also has the ability to weld, in two passes, the AISI-1100 series of sulphur-bearing or free-machining carbon steels. The first pass shows a small amount of porosity but a second, deeply penetrating pass eliminates this porosity and scavanges the remaining gas. The result is a solid weld which is strong and non-porous.

## NOPCO Moves to Newark

**Nopco Chemical Company** and its subsidiary, Metasap Chemical Company, has moved its general offices to 60 Park Place, Newark, N. J. The new headquarters will accommodate the firm's executive, accounting, advertising, and sales departments. The transfer to Newark will provide more space in Harrison for Nopco's expanded laboratory activities. The firm's engineering, legal, production, purchasing, receiving, and shipping departments will remain in Harrison.


TO SELL—ADVERTISE IN
WIRE AND WIRE PRODUCTS
It pays—send for rates
453 Main St., Stamford, Conn.



You don't have to stand on your head to observe specimen behavior in the . . .

COMPLETELY NEW **SCOTT CRE**

Constant Rate-of-Extension Tensile Elongation Tester

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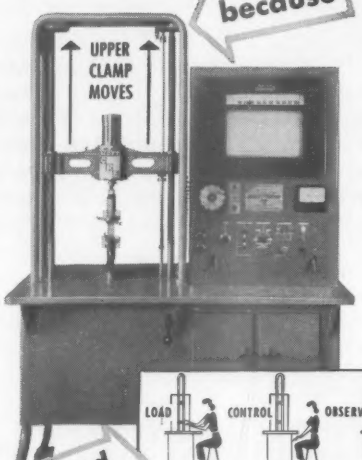
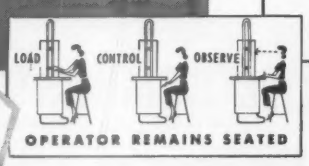



Here is the highest-known precision in a tensile tester at . . .

**LOW COST**

never before possible!

. . . and because




1. Permits use of all the Scott clamps and holding fixtures for conformance with ASTM, ISO, Govt. and Industry methods for testing wires, plastic, rubber, paper and textiles in the range of 0-.05 lb. to 0-1,000 lbs. or 0-25 grams to 0-500 kgs. tensile.
2. Crosshead travel up to 70".
3. Infinite variety of specimen extension speeds up to 20"/min with high-speed return.
4. 5 selective capacities, variable if desired by pushbutton during test.
5. Widely variable recorder registration speeds.
6. Elastomer pipping circuit.

Producing stress-strain information by the most precise electric weighing method known to science, the CRE Tester can be tailored to fit your production routine at SURPRISINGLY LOW COST . . . or equipped with your choice of optional additions for laboratory versatility.

***Tests both the Low-Elongation and High-Elongation Materials used in WIRE***

Opens a whole new world of stress-strain information on Wire, Insulation Sheath, Cable Components.

REQUEST NEW "CRE BROCHURE"

**SCOTT TESTERS, INC.**

55 Blackstone St., Providence, R. I.

*The Symbol of World-Standard Testing*

# Outstanding Personalities of the Wire Industry

### Ajax Electric Appoints Representatives

**Appointment** of the **Southwestern Engineering and Equipment Company,** 3906 Lemmon Ave., Dallas, Texas, has been announced by Sales Manager **E. N. Case** of the **Ajax Electric Company,** salt bath furnace manufacturers of Philadelphia. Starting July 1, Southwestern represents the complete line of Ajax furnaces and related control equipment in Texas, Oklahoma and Louisiana. In addition to its Dallas headquarters, southwestern has an office in Houston and also maintains a company airplane to facilitate service over the wide area covered.

* * *

**On** the Pacific Coast, Ajax representative **George Thurston** has joined forces with **George Howard** to operate as **Howard and Company** covering the San Francisco area. Both men have been active in the heat treating field for many years past.

### Makes European Tour

**Dr. F. R. Morral,** head of the Cobalt Information Center, Battelle Memorial Institute, Columbus, Ohio, left late in August for a visit to several European countries, among which are Norway, Sweden, Belgium, Germany, Switzerland, Spain, and England.

* * *

**Besides** visiting a number of industries and laboratories, he is scheduled to deliver talks before a half dozen technical groups and will arrive home around October 13th.

* * *

**Dr. Morral,** a member of The Wire Association, on a number of occasions has presented papers at our meetings and has been a frequent contributor to Wire and Wire Products.

### Magnuson Appoints Connecticut Representative

**Magnuson Products Corp.,** 50 Court St., Brooklyn 1, N. Y., has announced the appointment of **Clifford Oates** to represent the company in the State of Connecticut (except Fairfield County) on the sales and service of Permag compounds. His transfer will make available to concerns in this territory the advantage of his long experience in electroplating, wire and other industrial applications in which these compounds are useful.

### Blane Appoints Technical Director

**The** appointment of **James H. Pax** as Technical Director has been announced by the **Blane Corporation** of Canton, Mass., manufacturers of vinyl insulation compounds and vinyl color concentrates.

* * *

**Mr. Pax** has had many years of experience in research and new product development in the plastic and chemical industries. Prior to

CATALYTIC COMBUSTION

- **Reduces high operating costs**
- **Solves condensate problems**
- **Eliminates air pollution**

CATALYTIC'S SIMPLE, PATENTED, "ALL-METAL" CATALYST IS THE KEY THAT TURNS EXHAUST FUMES INTO ODORLESS HEAT . . . READY TO USE

Over 800 wire-enameling ovens, equipped with Catalytic Systems, no longer need be shut down for cleaning hazardous condensates. In addition to this saving of down time and operating costs, users tell us more uniform coatings result from ovens equipped in this manner.

More than 400 other ovens and furnaces are equipped with Catalytic Systems, supplied directly to the customer or through the oven builder. Many of these installations include provision for heat recovery. Ovens used for paint baking, paper and fabric impregnating, coating, lithographing, curing, drying, and many other processes comprise the list of Catalytic Systems in operation.

Air-pollution-control officers and insurance underwriters are constantly approving the safe, efficient performance of Catalytic installations.

Your inquiry will receive our prompt and confidential attention. Write us today!

U. S. AND FOREIGN PATENTS GRANTED AND PENDING

Catalytic Combustion CORPORATION

CATALYSTS • FUME ELIMINATION AND HEAT RECOVERY SYSTEMS

**4723 Fourteenth St., Detroit 8, Michigan**

joining Blane he was associated with the Kaiser Aluminum & Chemical Corp. as a technical specialist on all phases of wire coating problems. Previously, he was associated with the Goodyear Tire & Rubber Co.

★ ★ ★

**Mr. Pax** holds a B.S. degree from the University of Washington, where he also did graduate work. He also attended the Georgia School of Technology.

### Appoints Sales Executive

**Amchem Products, Inc.** (Formerly American Chemical Paint Company) announces the appointment of **Jack M. Price** as Assistant Sales Manager, Metalworking Chemicals Division. He will assist in the operation of the Central Sales Office and in the direction of the Central Staff and Field Sales activities.

★ ★ ★

**Mr. Price** originally joined Amchem as a sales representative in their New England territory. In 1954 he was appointed Assistant Manager, Eastern District and moved to the home office in Ambler. In May 1956 he was transferred to the Central Sales Staff, also in Ambler, as Assistant to the Sales Manager.

### Litzler Appoints Representative

**Ferd Muller** has been appointed northeastern district representative of the **C. A. Litzler Co., Inc.,** Cleveland, engineers and manufacturers of continuous web and strand process equipment for the synthetic fibre, rubber, plastics and wire industries.

★ ★ ★

**Well-known** in the rubber and textile fields throughout the world, Mr. Muller previously was associated with the Textile Department of Walter Kidde & Co., Inc., of which he was manager of sales and manufacturing, supervising both domestic and foreign operations.

★ ★ ★

**Making** his headquarters at 484 Bloomfield Avenue, Montclair, N. J., he will serve the New England states, New Jersey, Delaware, eastern New York and eastern Pennsylvania.

### Wright Promotes Two Men

**Two** officers were promoted at the recent annual meeting of **G. F. Wright Steel & Wire Company,** Worcester, Mass. **Merrill W. Wright,** with the company since 1940, was made vice president and general manager and **Eliot E. Swanberg,** with the company since 1944, was elected treasurer.

### New Cleveland Tramrail District Managers

**William P. Hanks** has been appointed Midwest District Manager and **Robert M. Underwood,** Northeast District Manager of the **Cleveland Tramrail Division of The Cleveland Crane & Engineering Company,** Wickliffe, Ohio.

★ ★ ★

**Mr. Hanks** formerly was South-


**NESOR ALLOY PRODUCTS CO.**

**MANUFACTURERS OF WIRE • STRIP • BRAID • STRAND**

**280 HALSEY STREET NEWARK, N. J.**

**FINE WIRE**

**TO .001**

**IN THE FOLLOWING METALS AND ALLOYS**

| | | |
|---|---|---|
| ALUMINUM- AND ALLOYS | MONEL-NICKEL | COPPERCOATED STEEL |
| BARE AND TINNED COPPER | STAINLESS STEEL | SILVER PLATED COPPER |
| LEAD AND SOLDER ALLOYS | STEEL-LOW AND HIGH CARBON | BRASS AND ALLOYS |
| PRECIOUS METALS | RESISTANCE WIRE | PHOSPHOR BRONZE |

Exacting size tolerances—uniformity of tempers, a good product and prompt service. A dependable supplier soliciting your business.

Consultation—Samples and Quotations Without Obligation.

"West Coast Representatives, Harry Appleton Co., Inc., 136 San Fernando Road, Los Angeles 31, Calif. Phone, CApitol 5-5611, Sales Engineers for Your Convenience."

Mid-West Representatives—Gassner & Clark Company, 6644 N. Western Avenue, Chicago 45, Illinois Tel.: Rogers Park 4-6121

ern District Manager and has been with Cleveland Tramrail for 32 years. Mr. Underwood was formerly located in California with the Crane Hoist and Engineering Co. in engineering and sales capacities.

### Warren Wire Appoints Representative

**Warren Wire Company,** Pownal, Vermont, has announced the appointment of **Charles S. Gery** as district manager in the State of Ohio.

★ ★ ★

**With** offices at 835 Williamson Bldg., Cleveland, Ohio, he will handle the company's line of magnet wire, bare and tinned copper wire, high-temperature Teflon wires, aircraft cables, lead wires and Teflon coated glass fabric and yarn.

### Chase Appoints Specialist for Stainless Steel

**Arthur W. Schriewer** of Springfield, N. J. has been named Eastern Regional Stainless Steel Specialist for **Chase Brass & Copper Co.,** a subsidiary of Kennecott Copper Corporation. The appointment, announced by **Walter E. Evans,** General Sales Manager for Chase, is effective immediately.

★ ★ ★

**Mr. Schriewer** was formerly Product Manager, Stainless Steel for the Edgcomb Steel & Aluminum Corp., Hillside, N. J., with which he had been associated since 1945. He will make his headquarters at the Chase New York warehouse in Maspeth, L. I., and will serve the company's seven Eastern sales districts.

### Directors of Engineering and Manufacturing Named at Heli-Coil

**Karl H. Epple** has been appointed Director of Engineering and **Edward W. McLaren** has been named Director of Manufacturing for the Heli-Coil Corporation, Danbury, Conn., (a Division of Topp Industries) manufacturer of Heli-Coil wire thread inserts and thread repair kits.

★ ★ ★

**Mr. Epple,** a graduate of Massachusetts Institute of Technology, started with Heli-Coil in 1953. **Mr. McLaren** is a graduate of Rensselaer Polytechnic Institute and Rutgers University and holds degrees in both Mechanical and Electrical Engineering. He joined the company in 1952.

### To Sell Wheelabrator Line on West Coast

**Thomas S. McCrory** has been appointed Regional Manager of **Wheelabrator Corporation's** West Coast sales organization. Mr. McCrory will make his headquarters in Los Angeles, supervising Wheelabrator's present Seattle, San Francisco, and Los Angeles territories.

★ ★ ★

**Mr. McCrory** served for 32 years in the United States Navy and attained the rank of Lt. Commander.


Newly Developed Modern *High Speed*

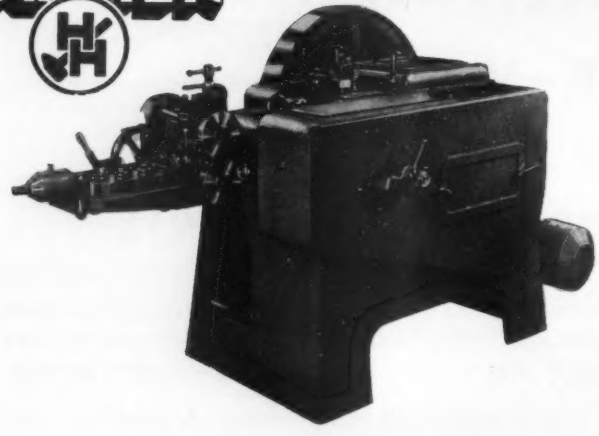
HEUER HAMMER H

Double-Stroke **COLD HEADER**

*for*

**BOLTS and NUTS**

**HEUER-HAMMER SYSTEM**



All moving parts run in oil bath housing, protecting them from dust, dirt and shavings.

Noiseless • Smooth Running
Minimum Wear • High Capacity • Long Life.

***Please ask for description and quotation.***

***Sole Representative:***

**PAUL REICHER MACHINERY**

P. O. Box 127
Willowdale, Ont. Canada

During this time he gained invaluable manufacturing and metal working experience at the Naval Gun Factory in Washington, D. C. and at the Naval Ordnance Plant in Charleston, South Carolina.

★ ★ ★

In 1952 Tom joined the Baldwin-Lima-Hamilton Corp., as a Sales Engineer. He was Western Sales Manager of their Niles Tool Division before joining Wheelabrator.

### To Head Ohio Office of Rome Cable

**Jack F. Guyer** has been named sales manager of **Rome Cable Corporation's** Cleveland, Ohio, district office, according to an announcement made in Rome, New York, by Glenn E. Rolston, marketing director of the wire and cable manufacturer. Mr. Guyer succeeds **C. L. Evans** who is retiring.

★ ★ ★

He formerly worked in the company's Pittsburgh, Pa., and Columbus, Ohio, offices as sales representative. He joined Rome Cable in 1939, shortly after graduating from the University of Pennsylvania.

### Representing Carpenter Steel in Los Angeles

**Robert W. Titgemeyer** has been named branch manager of the Los Angeles territory by **The Carpenter Steel Co.**, Reading, Pa. He started with Carpenter as sales engineer in 1947 and was appointed assistant branch manager in 1956. He is a member of the Society of Automotive Engineers.

### To Direct Zinc and Lead Research

A director has just been appointed to head the joint research program being initiated by worldwide lead and zinc producers. He is **Dr. Schrade F. Radtke**, until now director of the metallurgical research laboratories of Reynolds Metals Co. at Richmond, Virginia. The new joint research program has the support of lead and zinc producers in Australia, Canada, Britain, Mexico, South America, and the United States.

### Herbert C. Geittman, Jr.

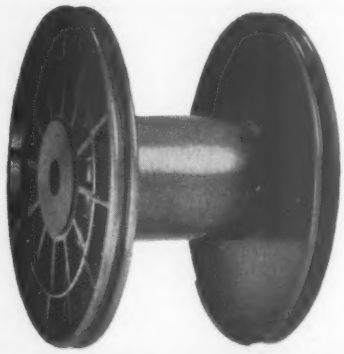
**Herbert C. Geittman, Jr.,** Sales Representative for **Climax Molybdenum Company,** a division of American Metal Climax, Inc., recently passed away. He joined the company in 1955 after service with the Richmond Foundry and Manufacturing Company, Inc., and with other foundries.

### David Rosen

**David Rosen** died suddenly on August 5, 1958 in Baden-Baden, Germany, while on a combined vacation and business trip through Europe. He was sixty-two.

★ ★ ★

**Mr. Rosen,** who founded **The**

YOU ASKED FOR It!

SO BOONTON NOW BRINGS YOU

A 6-INCH "PLASTISPOOL" . . .

AND LIKE THE REST OF OUR STURDY FAMILY OF FINE PLASTIC SPOOLS, IT IS

• SMOOTH
• RUGGED
• COLORFUL

*Write or phone now for samples and price list.*

BOONTON MOLDING CO.
BOONTON, NEW JERSEY TELEPHONE DEerfield 4-4400

**Nesor Alloy Products Company** in 1927 to manufacture fine wire and strip, was widely known throughout the wire industry. The plant is located at 282 Halsey Street, Newark, N. J. A surviving son, **Gerald Rosen,** as Vice President of the company, has been in charge of production and is a member of The Wire Association.

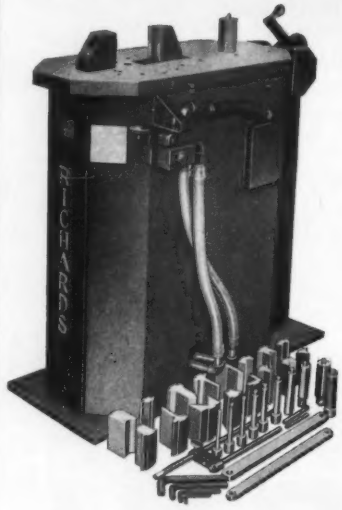
### Henry Harris

**Henry Harris,** founder and president of the **National Wire Die Co., Inc.,** New York City, died after a brief illness on Saturday, August 16th.

* * *

**Henry Harris** founded the National Wire Die Co. in 1935, and has from that time endeared himself to countless friends in the wire industry. The warmth and joviality that he inspired by his presence will be missed by all of his friends.


# MULTIFORM BENDERS



**Eliminate Special Tooling Cost**
**Reduce Set Up Time**
**Boost Production**

***IF***

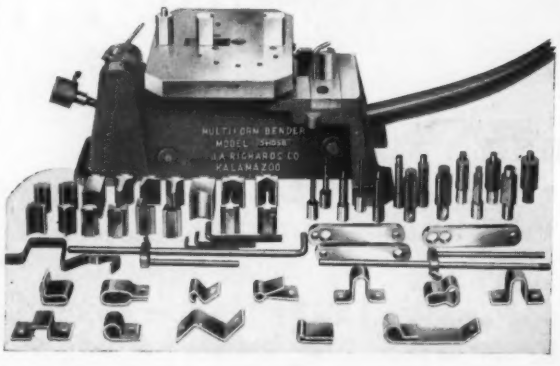
***Fabrication is a Problem Solve it with a Multiform.***

***Wire Forms - Bus Bars - Brackets - Stampings - Springs Steel Rule Dies etc.***

Big Brother — B Model

¼" x 4" Capacity
Air Operated

**J. A. RICHARDS COMPANY**
**KALAMAZOO, MICHIGAN**



***Write today for literature***

Hand and Air Models

At left is the No. 5HDSB MULTIFORM BENDER CUTTER. Capacity ⅛" x 1½".


### Kelso F. Birchmeier

**Wardwell Braiding Machine Company,** Central Falls, R. I., has announced with regret the passing of its plant Superintendent, Kelso F. Birchmeier, who died on August 14, 1958.

### To Head Military Sales for Auto-Lite

New head of Military Sales for **The Electric Auto-Lite Company's** Electrical Products Group is **John F. Carey.** His appointment to the new post implementing Auto-Lite's expanded research and development program has been announced by Group Vice President **J. J. Bohmrich.**

* * *

**With** headquarters in New York City, Mr. Carey will represent the Group's three divisions as well as the corporate research and development center in the extension to the military of specialized engineering and production skills and facilities in areas of sophisticated electronic and other advanced products and components. Since the first of the year Auto-Lite has undertaken an extensive research and development program utilizing the diverse skills of the company's 19 laboratories in development of new products, new markets and improved products.

### Carpenter Names Ross, High to Be Ohio Branch Managers

**Donald F. Ross** and **Harry L. High, Jr.,** have been named Ohio branch managers for Dayton and Cincinnati respectively by **The Carpenter Steel Co.,** Reading, Pa. Both started with Carpenter as sales representatives in 1953.

* * *

**Mr. Ross,** who became assistant branch manager in 1957, is a member of American Society for Metals, American Society of Tool Engineers, and the Tool Manufacturers Association of Dayton. Mr. High was named assistant branch manager of the Cincinnati area in 1956.

# A Review of Recent Wire Patents

**The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.**
**Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.**

No. 2,845,675, WIRE CLOTHESPIN, patented August 5, 1958 by George S. Tsuda, Hilo, Territory of Hawaii.

The pin is formed wholly of a single length of wire, bent to form jaws and a pair of handles.

★ ★ ★

No. 2,845,694, MEANS AND METHOD FOR FORMING COILS, patented August 5, 1958 by Robert G. LeTourneau, Longview, Tex., assignor to R. G. LeTourneau, Inc., Peoria, Ill., a corporation of California.

More specifically, the method is for forming two-layer wire coil sections for winding for dynamo-electric machines involving a wire coil-winding machine having a reversible shaft extending therefrom, a back-up plate, a wire coil form, a storage spool secured to the shaft outwardly of the back-up plate and form, and a supply spool which is free turning on an axle external to the machine.

★ ★ ★

No. 2,845,986, MACHINE FOR AUTOMATICALLY COILING STIFF WIRE INTO A HELIX, patented August 5, 1958 by Leonard O. Larsen and Warren O. Simpson, Indianapolis, Ind., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

The coiled wire moves axially of a coiling drum and is received by a tubular guide partially conforming to the successive turns of the wire, and, in turn, received from the guide by a fixed-position roller which engages the outer periphery of the coiled wire, and a roller, having a rocking movement, to engage the inner periphery of the coiled wire.

★ ★ ★

No. 2,845,987, SPRING COILING MACHINE WITH AUTOMATICALLY RECIPROCATING MANDREL AND AUTOMATIC WIRE FEEDING OF BROKEN OFF END TO AN AUTOMATIC PICK UP ON SAID MANDREL, patented August 5, 1958 by Harry J. McCullough, Redwood City, Calif., assignor to Federal-Mogul-Bower Bearings, Inc., Detroit, Mich., a corporation of Michigan.

There are 37 claims in this patent, the title of which aptly describes the kind of machine disclosed.

No. 2,847,170, WINDING APPARATUS FOR DISTRIBUTED WOUND STATORS, patented August 12, 1958 by John F. Lill, Fort Wayne, and Robert J. Eminger, Kendallville, Ind., assignors to Fort Wayne Tool, Die & Engineering Company, Fort Wayne, Ind., a company of Indiana.

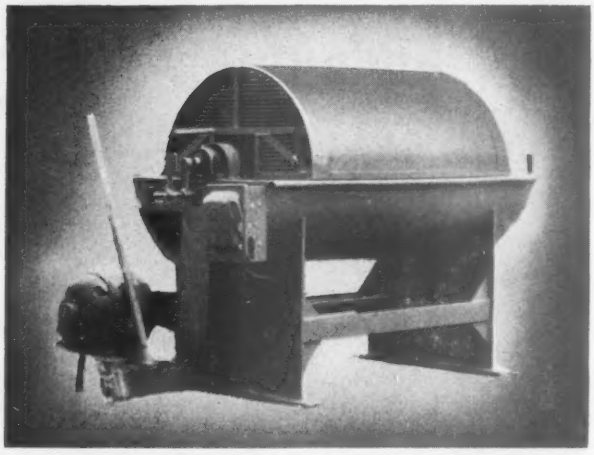
The apparatus is of the type in which a winding head moves relative to a slotted stator in a path sequentially parallel to and transverse to the axis of the stator bore in placing a winding between two angularly separated stator slots.

★ ★ ★

No. 2,847,171, WIRE COILING APPARATUS, patented August 12, 1958 by James E. Keesee, Jacksonville, Fla., assignor to Mid-States Steel & Wire Company, Jacksonville, Fla., a corporation of Indiana.

This coiler is of the wire-receiving rotatable shaft and tapered block type. The block has a flange at its larger end, over which the wire is guided and then coiled on the block, with an elongated guide rod extending forwardly and laterally from the smaller end of the block to receive coils of wire from the block. There is also a device engaging the end of the guide rod to hold it against vertical movement thereby to hold the block against rotation.

★ ★ ★

Reel Capacity ..... 200#
Speed ..... 3000 Twists P.M.
Motor ..... 3 H.P.
Traverse ..... 8 inches
For Strand ..... #22 to #12

**HIGH PRODUCTION AT LOW COST . . . .**

**WE BELIEVE THIS TO BE THE HIGHEST PRODUCTION BUNCHER IN THE WORLD**

Reel Capacity ..... 25#
Speed ..... 5000 Twists P.M.
Motor ..... 1 H.P.
Traverse ..... 6 inches
For Strand ..... #33 to #22

Reel Capacity ..... 1000#
Speed ..... 2000 Twists P.M.
Motor ..... 3 H.P.
Traverse ..... 12 inches
For Strand ..... #22 to #10

WRITE OR CALL FOR DETAILS TO FIND
THE ANSWER TO YOUR PRODUCTION — COST RATIO

**LARIBEE MACHINE CO., INC. • CAMDEN, NEW YORK**

PHONE: CAMDEN 42

No. 2,847,172, COILED MATERIAL DISPENSER, patented August 12, 1958 by Joseph L. Salkield, Cupertino, Calif.

The reel of this wire dispenser is composed of flexible elongated elements arranged together in the general form of a cone.

★ ★ ★

No. 2,848,038, SPRING UNITS FOR UPHOLSTERY FOUNDATIONS, patented August 19, 1958 by Albert M. Bank, Jersey City, and Alex J. Katz, West Orange, N. J., assignors to Super Sagless Spring Corp., Hoboken, N. J., a corporation of New Jersey.

A wire upholstery unit is disclosed of zig-zag spring formation comprising a main zig-zag spring and an auxiliary one connected together. There are 10 claims.

★ ★ ★

No. 2,848,040, BABY SUPPORT, patented August 19, 1958 by Victor A. Chernivsky, Downers Grove, Ill.

This support is comprised of bent wire and includes a base and a back support.

★ ★ ★

No. 2,848,177, COIL SUPPORTING HEAD FOR METAL STRIP UNCOILERS, patented August 19, 1958 by Kenneth L. Bandy, Canfield, Ohio, assignor to The McKay Machine Company, Youngstown, Ohio, a corporation of Ohio.

The head comprises a heavy generally circular body member having a number of angularly spaced radial slots therein, with slide members mounted in the slots for radial movement, and coil supporting chuck segments mounted on the slide members which have outwardly extending flanges, the outer edge portions of all of the flanges having gear teeth, pairs of pinions journaled on the coil supporting head between and meshing with the gear teeth of adjacent slide members, alternate ones of the slide members having piston members received therein and piston rods connected to the piston members and the spindle.

★ ★ ★

No. 2,849,031, WIRE FORMING MACHINE, patented August 26, 1958 by Svend G. Blumensaadt, Beachwood Village, Ohio, assignor to The Universal Wire Spring Company, Bedford, Ohio, a corporation of Ohio.

A machine of the forming pin type is disclosed, there being 11 claims.

★ ★ ★

No. 2,849,056, SUPPORTING MEANS FOR SINUOUS SPRINGS, patented August 26, 1958 by Hyland C. Flint, John F. Hern, and Russell G. Heyl, Jr., Birmingham, Mich., assignors to American Metal Products Company, Detroit, Mich., a corporation of Michigan.

A spring strip made of wire bent back and forth to form transverse torsion bars joined by longitudinally extending bendable bars is disclosed with a straight bendable bar extending outwardly from the end of the endmost torsion bar in aligned relation to other of the bendable bars forming anchoring means by which the spring is secured to a framing member.

★ ★ ★

No. 2,849,057, WIRE SPRING MEMBERS AND STRUCTURES, patented August 26, 1958 by William H. Neely, Cleveland, Ohio, assignor to The Universal Wire Spring Company, Bedford, Ohio, a corporation of Ohio.

This wire spring structure includes axially aligned oppositely disposed pairs of longitudinally spaced accordion-fold wire members, with two zig-zag wire strips for each aligned pair of members, each strip being supported on two axially aligned accordion-fold wire supporting elements.

★ ★ ★

No. 2,849,195, COMBINATION WIRE DRAWING AND PACKAGING DEVICE, patented August 26, 1958, by William H. Richardson, Mount Carmel, and Joseph J. Kovaleski, Ansonia, Conn., assignors to The Driscoll Wire Company, Shelton, Conn., a corporation of Connecticut.

A rotatable drum is disposed below a rotatable capstan for receiving the wire therefrom, with a device for varying the angular velocity of the drum with respect to that of the capstan.

★ ★ ★

No. 2,849,526, SUBMARINE CABLE, patented August 26, 1958 by Robert Alston Brockbank, Kenton, England.

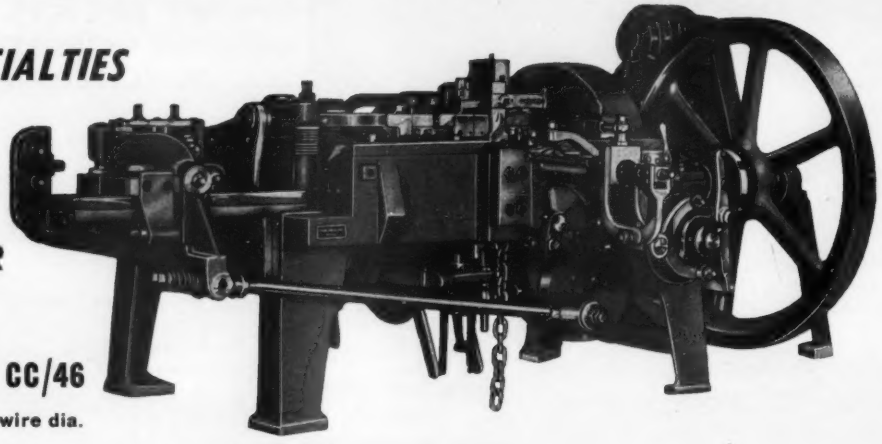
This coaxial submarine cable for high frequency signalling consists solely of a steel wire strength core having a plurality of layers of steel wires of opposite


EW

ALL MACHINES FOR PRODUCING AND WORKING THE METALLIC WIRES

OUR SPECIALTIES

AUTOMATIC CHAIN BENDER



Model CC/46

up to 1" wire dia.

Please, contact us.

Emilio Wartenweiler

MILANO (ITALY)

VIA G. B. PERGOLESI No. 18

lay so that the core undergoes substantially no twisting under tension, the core constituting the sole tension sustaining element of the submarine cable with two metal conductors surrounding the core and extending longitudinally thereof in the form of longitudinal sleeves.

## Steel and Wire Machinery to Handle Farmer Norton Wire Equipment in U.S.A.

**Steel & Wire Machinery Co.,** 15457 Euclid Ave., Cleveland 12, Ohio, has recently been appointed sole U.S.A. Representatives for Wire Drawing Machinery and Chain Link Fencing Machinery manufactured by **Sir James Farmer Norton & Co., Ltd.,** Manchester, England.

★ ★ ★

**The** Farmer Norton Company builds a complete line of multiple and single block wire drawing machines for handling all sizes of wire.

★ ★ ★

**Multiple** Block Equipment includes Farmer Norton Concentric Machines. This is a straight line non-slip accumulation type machine of double block design for high speed drawing. The double block design provides excellent cooling between drafts and allows non-stop drawing even while stripping the finishing or winding block.

★ ★ ★

**Single** blocks are available of conventional or Gravity Block design. The Gravity Block is of inverted design with block diameters from 18" to 30" either single or double draft. Horsepower ranges up to 90 H.P. for double draft machines. Primary advantage of this type of block is obviously the ease of handling large coils. Farmer Norton has built Gravity Blocks for handling one ton and larger coils. A unique stripper design allows stripping full coil and replacing with empty swift or stripper in 25 seconds.

★ ★ ★

**Inverted** or Gravity Blocks are also used as finishing blocks on Multi-Block Machines and as take-up frames for in-line cleaning, galvanizing or heat treatment.

★ ★ ★

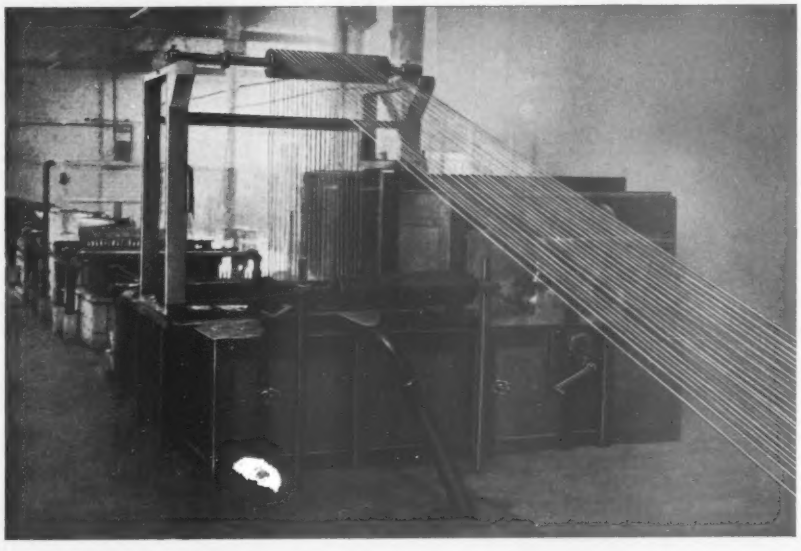
**Farmer Norton** has built Wire Drawing Equipment for all types of material ranging from low carbon steel through alloys and including such non ferrous materials as copper, brass, nickel silver, nickel chrome, aluminum and tungsten. Over 100 years of experience assure practical knowledge to supply equipment designed to provide best production rates with a minimum of labor cost.

★ ★ ★

**The** Farmer Norton Chain Link Fence Weaving Machine is available in sizes providing up to 12 feet width of fence. The machine is fully adjustable to weave from .080" to .192" diameter wire into 1¼" to 4" meshes. Practical production speed on 2" mesh: 1750 Square feet per hour on 4 foot width!

★ ★ ★


# CERAMIC TANKS ARE MAKING HEADWAY!



COVER HEATED galvanizing furnace for wire
(German and Foreign Patents issued)

## Why?

- Unlimited pot life
- No penetration or erosion
- Less dross
- Low installation costs
- No zinc run-out channels
- Easy temperature control

★

for
WIRE, HEXAGON NETTING STRIP, and PIECE GOODS

★

Operation by Gas or Oil

★

*Please write for details.*

*Sole Representative for USA and Canada*
**PAUL REICHER**
P.O. Box 127, Willowdale, Ont., Can.

**OFENBAU FRITZ G.m.b.H. HAGEN i.W., W.-GERMANY**

The company also manufactures Bar Draw Benches, Tube Draw Benches, Rolling Mills, Flattening Mills, Slitters and Pointers. Steel & Wire Machinery Co. will be pleased to submit complete technical information on any of this equipment.

★ ★ ★

At the Annual Convention of The Wire Association in Atlantic City, October 13 to 16, representatives of Steel & Wire Machinery will show two films of the Farmer Norton high speed Concentric Machines and Gravity Blocks in actual production in customers' plants.

## New Staples for Ground-Wire Plastic Molding

New utility staples manufactured by **E. H. Titchener and Company,** are designed especially for use with the newly developed plastic molding for ground wires on utility poles. The lightweight plastic molding, combining high impact strength, long life, low cost, and superior corrosion resistance, replaces the much larger wooden molding conventionally used for such ground-wire applications. The staples are available in three sizes to accommodate plastic molding with inside diameter of either ½", ⅝", or ¾". Inside lengths of #9-gauge wire staples for ½" and ⅝" molding are 1-⅞" and 2", respectively. Staples for ¾"-i.d. molding are #8-gauge wire, 2¼" inside length. They are made either of copper-ply or Bethanized wire.

★ ★ ★

**Staples** are packed 500 pieces per box, 5 boxes to each shipping carton. Staple dimensions can be modified to meet any special requirements. For further information and free samples of Hold-Tite Molding staples, write E. H. Titchener and Co., 67 Clinton St., Binghamton, N. Y.

## New Bulletin Describes Reliance Drives

A new 16-page, full-color booklet thoroughly describes Reliance V*S Drives, which provide precise, adjustable machine speeds from in-plant a-c circuits.

★ ★ ★

**The** booklet, Bulletin D-2506, illustrates in brief copy and full-color photographs and diagrams how V*S Drives operate and may be applied to various types of machinery in all industries. The manufacture and functions of the drive components, including regulators, exciters, motor-generator sets, operator's panels and Super 'T' motors are graphically covered. The bulletin also lists condensed drive specifications, dimensions and accessories.

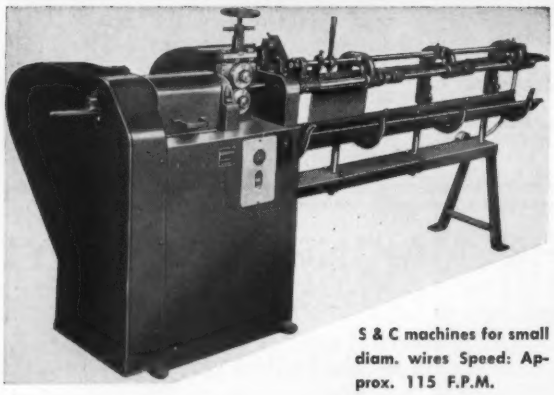
★ ★ ★

**Copies** of the bulletin may be had free by writing **Reliance Electric and Engineering Co.,** 24701 Euclid Ave., Cleveland 17, Ohio.

## Catalytic Unit for Enameling Ovens

A line of standard fume combustion units for vertical wire enameling ovens is announced by


# New! Improved! Fast!
# WELLS STRAIGHTENER & CUTTER



S & C machines for small diam. wires Speed: Approx. 115 F.P.M.

**This completely redesigned line combines maximum efficiency with that rugged dependability, for which WELLS S&C machines have become justly famous.**

**Built in several sizes to handle 2 to 18 ga. basic and high carbon wire.**

***FEATURES***

**The guide bar of these new machines can be supplied for any cut lengths • The rotary flier runs on ball bearings for smoothness and long life • Cut-off is actuated by a solenoid for extreme accuracy of cut lengths • A two point cam construction provides a quick and positive return of the cut-off knife, eliminating the need for a clutch and dog • A counter is standard equipment.**

A COMPLETE RANGE OF S & C MACHINES IS MADE BY WELLS FOR ALL SIZES OF WIRE. SEND FOR CATALOG ON THE COMPLETE LINE.

*Frank L. Wells Company*

***Builders of Fine Wire Working Machinery***

**5821 FIFTH AVENUE • KENOSHA, WISCONSIN**

the **Catalytic Combustion Corporation,** Detroit 8, Mich. Employing a metallic constructed, unbreakable catalyst, this line incorporates such desirable features as have been field proven on earlier designs.

★ ★ ★

**Although** approved fume elimination is accomplished, the primary function of the equipment is to improve operation of the oven, reduce frequency of shut-downs, and to minimize fire hazard, formerly caused by condensate in exhaust ducts. Greatest operating advantage is the fact that ovens can now be operated continuously, for a year or more, without the need of scrap-loss due to oven shut-down for duct cleaning. Incorporating precision controlled oven exhaust, oven fuel consumption is somewhat reduced, and quality of wire is made independent of natural stack draft.

★ ★ ★

**The** unit comes fully assembled, all ready for mounting on the top of the oven, with factory-wired operating control panel.

## Plastic for Insulated Wire

**Apex Tire and Rubber Company,** Pawtucket, R. I., has issued a comprehensive 63 page catalog on its vinyl compounds, which in effect is a series of technical data sheets covering its many products.

★ ★ ★

**The** catalog is conveniently indexed by means of tabled dividers, each labeled with its subject. These groupings include Wire and Cable, Profile Extrusion, Injection Molding, Special Uses, and Testing Procedures.

★ ★ ★

**In** the Wire and Cable Section are 20 such data sheets, preceded by an index covering the 20 compounds that gives applications, hardness, specific gravity and prices. Similar arrangements are followed for other sections.

★ ★ ★

**For** a copy, address the company at 505 Central Ave., Pawtucket, R. I.

## New Nylon Spool Announced

**Plastic Mold & Engineering Co.,** 157 Clifford St., Providence 3, R. I., has announced the perfection of a new wire braider spool of standard 16 and 24 carrier sizes, molded from tough du Pont "Zytol" type Nylon plastic.

★ ★ ★

**The** spools are highly accurate, will not break, chip or warp, have no burrs and will not deform when dropped or mishandled. They are inexpensive, and increase operating economics.

**Going** under the trade name, "Plamenco", these new spools are advantageous for all wire braiding operations. A full line of other spools are also made. Write the manufacturer for full details.

## New Catalog on Finishing Compounds for Insulated Wire

A comprehensive new 27 page catalog on finishing compounds for insulated wire has been issued by **Carbro Chemical Co.,** Dunnell Lane, Pawtucket, R. I.

★ ★ ★


# THE NEW LOOK

***IN DIAMOND DIES***

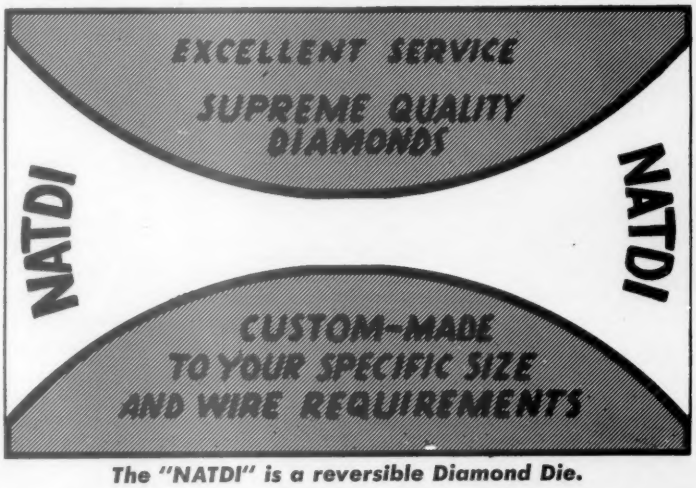
***Has swept the country!***
***It answers the need for lower production costs.***

**GET THE UTMOST LIFE AND SERVICE**
**FROM YOUR DIAMOND DRAWING DIES.**

## NATIONAL WIRE DIE CO., INC.

**PRESENTS**

## THE "NATDI"




***The "NATDI" is a reversible Diamond Die.***

**Since its introduction four years ago, "Natdi" has emerged with flying colors! Take advantage of customers' reports of:**

1. **TREMENDOUS INCREASE IN INITIAL SIZE PRODUCTION.**
2. **AMAZING ABILITY TO BE RE-CUT WITHOUT SKIPPING SIZES. THIS MEANS MORE RE-CUTS PER DIE.**

***Our representatives will gladly call on you at your convenience.***

**NATIONAL WIRE DIE CO., INC.**
12 West 21 St., New York 10, N. Y.

**Telephones:**
**WAtkins 4-6383 & 6384**

**The** Carbro line is comprised of non-metallic sheathed and service entrance finishers, Thermoplastic and switchboard wire finishers, code wire paints or lacquers, neoprene jacketed cable paints, aluminum varnishes for shipboard cable, pre-saturants for supply packages, saturants for wire and cable assemblies, asbestos covered wire compounds and miscellaneous special products.

★ ★ ★

**Descriptions** and operating setups for each compound are given, making the catalog a useful handbook on the use of wire and cable finishing materials.

★ ★ ★

**Copies** of the catalog will be sent to interested persons upon request.

## Sunbeam Acquires Furnace Division of Westinghouse

**Sunbeam Equipment Corporation,** a newly formed subsidiary of **Sunbeam Corporation,** Chicago, has purchased most of the assets formerly used by the Industrial Furnace Division of **Westinghouse Electric Corporation,** including the design and engineering files, equipment and production facilities occupying a 9 acre plot at Meadville, Pennsylvania. The property was tranferred August 15.

★ ★ ★

**The** Westinghouse Meadville operation included a line of industrial furnaces for production processing, designed for all types of fuels. Sunbeam will produce similar type equipment and manufacture service and replacement parts for equipment previously produced in Meadville.

★ ★ ★

**The** Sunbeam-Stewart furnace division, which has been producing industrial heat treating furnaces for over fifty years will be transferred from Chicago, Illinois to the new subsidiary and continued in Meadville.

## Wire Fabricator Announces Change of Address

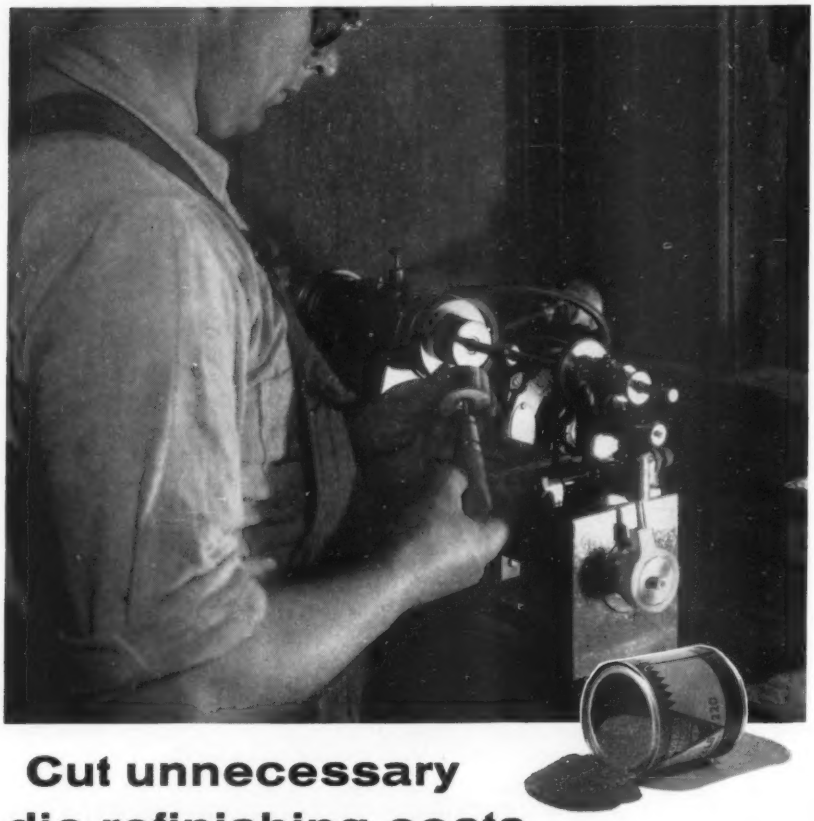
**Effective** September 30, **Universal Wire Products, Inc., discontinued** its P. O. Box address in Branford, Conn. The company has maintained this address to avoid delays in mail, despite the fact that it is two years since they moved from Branford. The post office address now is P.O. Box 395, North Haven, Conn.

## Booklet of Helpful Hints on Fasteners

**A** 16-page illustrated pocket-size booklet "Helpful Hints" has been published by **Russell, Burdsall & Ward Bolt and Nut Company.** It contains technical facts to help users obtain maximum economy and performance in application of standard fasteners, pointing out how savings and stronger assemblies can be realized by proper fastener application.

★ ★ ★

**Information** is contained on selecting the right grade of bolt, proper torque for bolts, bolt stresses, calculating proper bolt loading, tightening limitations, safety factor, threads and protective coatings. Important facts about nuts—grades, strength, use and abuse—

**Cut unnecessary die refinishing costs**

Next to diamonds and diamond dust NORBIDE* grain is the hardest manufactured abrasive commercially available. It costs 500 times less than sized commercial diamonds, bringing steady savings to refinishing operations on wire drawing dies — including ripping, semi-finishing, and, often, finishing. It will pay you to investigate the savings from NORBIDE abrasive. For details and prices write NORTON COMPANY, 45 New Bond St., Worcester 6, Massachusetts. G-350

NORTON
BORON CARBIDE
*Making better products... to make your products better*

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

**NORTON PRODUCTS** Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals
BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

are given. A section is devoted to selection of tapping screws; charts show safe load curves and torque curves for various diameters and grades of bolts.

★ ★ ★

**Copies** of the booklet can be obtained by writing Russell, Burdsall & Ward Bolt and Nut Company, 101 Midland Ave., Port Chester, N. Y.

## New In-Line Helical Gear Drives

**Folder** 2651-A, a new six-page supplement to Link-Belt Book 2651, contains complete data on horsepower ratings, dimensions, mounting information and a resume of construction principles applying to the completely new quadruple reduction speed reducers.

★ ★ ★

**This** supplement also contains information on two sizes of double reduction helical gear drives and three sizes of triple reduction helical gear drives in addition to the five sizes of quadruple reduction gear drives.

★ ★ ★

**Addition** of the quadruple reduction drive to Link-Belt's line of double and triple reduction drives now gives the company the most comprehensive line of In-Line Helical Gear Drives available to industry today. Copies of Folder 2651-A can be had by writing to **Link-Belt Company,** Dept. PR, Prudential Plaza, Chicago 1, Ill.

## New Motor Overload Control

**A** new fast-acting electrical control device which, for the first time, makes it possible to stop an overloaded electrical motor during the critical peak or starting load period, has been developed by **Baker Perkins Inc.,** Saginaw, Mich. The new unit also provides the protective functions that relays presently on the market give when more than normal running currents occur after starting.

★ ★ ★

**Designed** to respond instantly to all momentary overloads, the safeload relay, as it is called, is applicable to nearly all types of motorized equipment — ranging from single-motor machine tools and conveyors to multi-motored transfer and automatic setups.

★ ★ ★

**The** new control relay can be reset as instantly as it cuts off electrical current to the drive involved. A setting button makes it possible to set the current-controlling pointer at any current value desired. To start a motor after a safety shut down, a small push button micro-switch is provided.

## New Catalog on the Manco Guillotine Line

**Manco Manufacturing Co.,** Bradley, Ill., has published a new catalog, No. 158, covering its complete line of cutters for wire, rod, billets, strip, tubing and wire rope, and their benders, riveters, straighteners, valves and power units.

★ ★ ★

**The** catalog, which is tab-indexed for each type of equipment, is available upon request to the company.

Far greater production in less space with lower cost equipment . . . for all steel and non-ferrous wire.
The fastest, most uniform way to heat treat wire* is often far lowest in cost!
AJAX
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electric SALT BATH furnaces
* Write for case history bulletins on Ajax Electric Salt Baths for
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## Spooling of Fine Wire

(*Continued from page* 1228)

### Plastic Spools

It has been our practice (and the practice of many others in the fine wire industry) to wind fine wire onto metal spools for shipment to the customers.

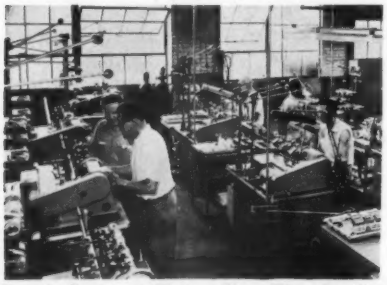


Fig. 9—Group of Meteor Fine Wire Spooling machines.

This spool is a so-called No. 1 spool with a head diameter of 2-½", a traverse length of 3", a barrel diameter of 1-½" or 1-¾", and a bore of ⅝". This No. 1 spool is available in aluminum or steel (steel is coated by tinning, enameling, etc.).

★ ★ ★

Metal spools, after being returned by customers, were reconditioned and re-used many times, but we were constantly seeking a comparatively inexpensive nonreturnable spool of precision dimensions. This would permit utilizing a new spool for each final spooling operation, providing a generally improved winding throughout the spool.

★ ★ ★

Early in 1953 it was decided to investigate the possibility of obtaining and using a No. 1 plastic spool. Plastic spools of this size were not available, so this became a complete development program which included determining the best material, designing the spool and the mold, and testing the plastic spool under load in various ambient conditions.

★ ★ ★

The aim was to develop a plastic spool which would be less expensive than our metal spools. We began a cooperative program with Boonton Molding Company, Boonton, N. J. As soon as a usable spool design was evolved, various plastic materials were tried and tested. The material which was finally adopted is a high impact polystyrene known as Styron 475 (The Dow Chemical Co.). Styron 475 is a thermoplastic which has three to five times greater impact strength than general purpose polystyrene. The molding machines for the spool are shown in Figure 10.

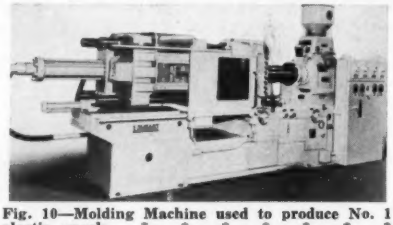


Fig. 10—Molding Machine used to produce No. 1 plastic spools.

For spooling fine wire, the following spool qualities are desired: precision dimensions, light weight, high strength, good ballooning


NEW IMPROVED **"NEPTUNE"**

**A NEW "THREE-IN-ONE" PICKLING COMPOUND**

1. INHIBITOR CONTENT—saves acid and metal.
2. ACCELERATOR CONTENT—promotes rapid pickling cycle.
3. FOAMING CONTENT—foam holds down fumes and acid spray.

**Inhibitor - Accelerator - Foamer - ALL IN ONE COMPOUND**

***For further details — samples — or trial lots, write to***

**PARKIN CHEMICAL COMPANY**

**Highland Building • Pittsburgh, Penna.**

surface and non-returnable.

★ ★ ★

When spooling .001" diameter wire on a multi-head machine with a single traverse control, it is mandatory that the flange to flange dimensions of the spools be uniform (within ±.001") or else non-uniform spooling will result. The metal spools, particularly after re-use, did not meet this requirement. The plastic spools have precision dimensions which permit taking advantage of the micro-adjustments on new spooling equipment.

★ ★ ★

The No. 1 plastic spool weighs .17 pounds compared to .18 for the steel spool and .16 for the aluminum spool.

★ ★ ★

Very high compressive forces are generated when building up repeated layers of fine wire. Figure 11 shows the design changes which

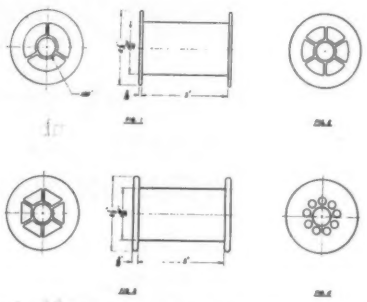


Fig. 11—Sketch of design changes made to streng hen the No. 1 plastic spool. No. 1 shows original design; No. 2 shows first revision from 3 to 6 ribs; No. 3 shows heavier barrel section; No. 4 shows current design.

have been made to give the spool the necessary strength, particularly to withstand "overloading."

★ ★ ★

In the original design, three ribs were used to support the barrel, and the spool head was 3/32" thick. Experience showed that when this spool was "overloaded," the barrel would tend to collapse, particularly in the area between the ribs. The design was changed to provide six ribs to support the barrel. This was an improvement; however, some failures still occurred. A further change was made by eliminating the radius between ribs to make a thicker barrel section. The final design, shown as Step #4, provides excellent strength and will not collapse even under extreme "overloading."

★ ★ ★

Styron 475 is resistant to oils and other commercial lubricants and will withstand temperatures as low as 32°F and as high as 150°F.

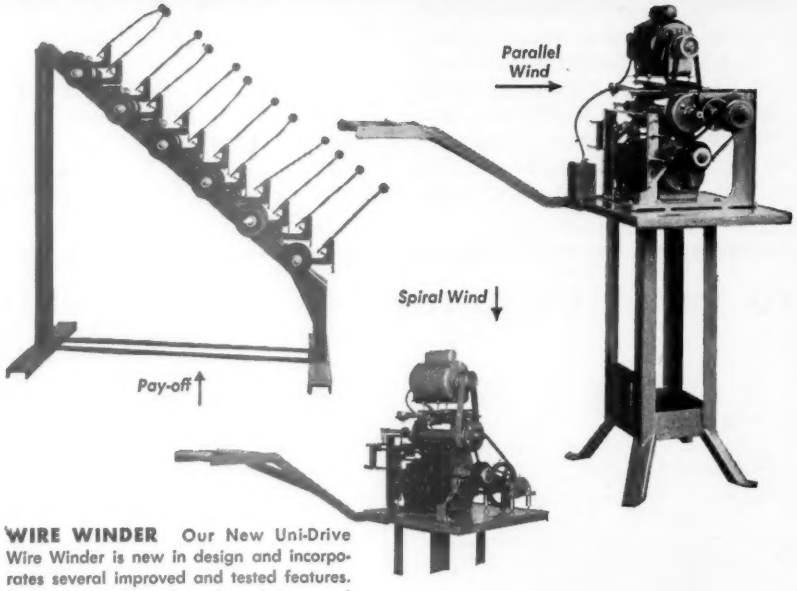
★ ★ ★

The smooth texture of the plastic provides a very good ballooning surface and eliminates the need for the plastic cap formerly used when ballooning from a metal spool.

★ ★ ★

All fine wire is shipped on new plastic spools, and we do not request that customers return these spools as was the case when using metal spools. It has been determined that the plastic spool can be re-used many times and these spools are being re-used in our processing operations. Boonton Molding Co. has remelted some used spools and cast this material into new spools. We are currently testing these recast spools in our plants and results to date indicate that the properties of the recast material are as good as virgin material.


STANDARD UNI-DRIVE WIRE WINDER




**WIRE WINDER** Our New Uni-Drive Wire Winder is new in design and incorporates several improved and tested features. Production is stepped up through increased speed. It produces smooth, even and accurately wound spools of wire in single or multiple ends. All strands parallel — no over or under-winding. Can also be furnished with a slight spiral pattern for winding exceedingly fine wire. Automatic Stop Motion controls each strand. Traverse adjustable from 1¾" to 5½" between spool heads without changing cam. Designed especially for winding wire to be braided and shielded for electrical conductors.

*Various types of supply packages that may be wound on Standard Uni-Drive Wire Winder.*

**PAY-OFF** Our Pay-off Attachment consists of a heavy fabricated frame on which Pay-off spools are mounted to cover desired number of ends to be wound. Equipped with spindles, running on self-aligning ball bearings, with size of spindles and adapters to accommodate customers' pay-off spool. Compensating Attachment to control the tension of each individual strand of wire, applying the same tension when spool is full as when empty. Can also be adapted for use with bunching machines.

STANDARD MILL SUPPLY COMPANY
31 ESTEN AVENUE PAWTUCKET, R. I., U. S. A.

A No. 3 (3-lb. capacity) and a No. 5 (5-lb. capacity) plastic spool have been developed and are in use. A No. 8 (8-lb. capacity) plastic spool is being developed. The No. 1 plastic spool has been so successful that it is becoming a standard for the industry.

* * *

**This** investigation has determined the basic factors which produce good spooling and this information applied on precision spooling equipment and the new plastic spool have promoted a superior package of fine wire.

## Patent Pending on Magnet Wire Coating

**Italian** patent number 551714 has been issued to **Schenectady Varnish Company, Inc.,** Schenectady, N. Y., covering the composition and use of a polyester resin applied from solution on wire. Properly cured, such enameled magnet wire is used for winding coils of motors, generators, transformers and other electrical equipment requiring resistance to high operating temperatures.

* * *

**The** resin, trade-named "Isonel" wire enamel, will withstand long-time operation at 155 C, according to the manufacturer. It is applied by conventional methods and has good chemical, electrical and physical characteristics. U. S. patents on Isonel wire enamel are pending.

## Acquires Rights to Winding Equipment

**Sealol Winders, Inc.,** 171 Post Road, Providence 5, R. I., a newly formed subsidiary of the Sealol Corporation, has announced the purchase of the rights to the manufacture and sale of Temco Winders.

* * *

**These** winders, developed some 8 years ago, provide automatically controlled constant tension in the winding of wire or textile and plastic yarns. This is accomplished through a closed hydraulic circuit in conjunction with a differential gear box. They are available in a number of sizes up to 100 H.P., each size capable of producing predetermined tensions from zero to maximum capacity.

* * *

New officers of the company are **C. W. Williamson,** President; **C. Duncan Briggs,** Manager; and **Frank Bottomly,** Vice President.

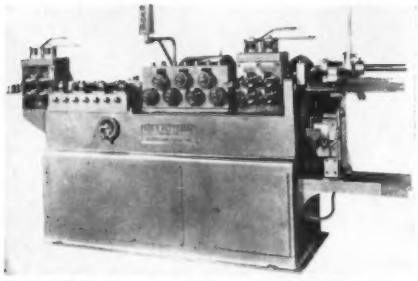
## Spring Testing Equipment

**The Carlson Company,** 3457 Weidner Ave., Oceanside, L. I., N. Y., has purchased the entire inventory of the Reicherter Elasticometer spring testing equipment from the Testing Equipment Co.

* * *

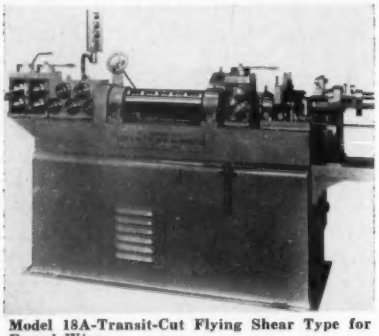
**This** equipment, valued at over $100,000, is offered at attractive reductions in prices and embodies testing equipment ranging from 1/64th oz. to 10,000 lbs. A substantial stock of replacement parts was also acquired and will be


**TO THE FABRICATORS OF WIRE PRODUCTS and THOSE WHO STRAIGHTEN & CUT WIRE OR BAR**



Model 9B-Stationary, quick cut for Square and Rectangular material.
* Capacity ½" Square or Equivalent area.

Consult with PATTERSON on Ways and Means to combat ever rising costs. PATTERSON not only offers the conventional Wire Straightening and Cut-off Machines, but has incorporated Forming, Bending and Die Operations on Round, Flat or Shaped Wire from the coil and does it **AUTOMATICALLY At Much Higher Speed**



Model 18A-Transit-Cut Flying Shear Type for Round Wire.
* Capacity 5/32" thru 3/8".

PATTERSON has the size and type machine for practically all requirements, *from .015 diameter to 1" Round or Equivalent area. Variable feeds and speeds, electric trip, roll type and air clutches.

* Capacities based on low carbon or non-ferrous wire

Support and Patronize the firm
"Whose Business is Helping Yours"
Now is the time to plan for tomorrow

**GEO. C. PATTERSON MACHINE CO.**
3409 Trumbull Street, Cleveland 15, Ohio • 'Phone: Broadway 1-1808

carried in stock.

★ ★ ★

**Orders** for Reicherter equipment should hereafter be directed to The Carlson Company, who will also provide service for the repair and recalibration of old testers.

### Sauereisen Acquires Electrical Cements

**Sauereisen Cements Company,** Pittsburgh, Pa., has acquired all manufacturing and sales rights for the various electrical cements developed and marketed by **Orefraction, Inc.,** Pittsburgh, Pa.

★ ★ ★

**By** acquiring these famous electrical insulating cements, the Sauereisen Company can provide customers with a more complete line of scientifically developed cements to meet the special needs of industry.

★ ★ ★

**Because** of their high electrical insulation values these cements are ideal for assembling, insulating and sealing applications on appliances, heating elements, coils, ceramic cores, instruments, resistors, switches and electronic equipment.

### New Bulletin in Butt Welders

A new data sheet bulletin on their heavy duty, automatic butt welders has been issued by the **Acme Electric Welder Company,** 2618 Fruitland Ave., Los Angeles 58, California.

★ ★ ★

**The** machines, Type B-01, 10-15-20 KVA, is designed to butt weld ⅜", ½" and ⅝" round steel rods. Construction is compact and rugged, machines are economical to operate, and they embody many advanced design features in cooling, push-up mechanism, heat regulation and timing control. The welders are supplied for standard or specified voltages.

★ ★ ★

**For** a copy of Bulletin B-1, please address inquiries to the company.

### Acknowledgement

**In** the story of the West Coast Regional Meeting of the Wire Association in Los Angeles on June 5 and 6, 1958, no mention was made of the sponsors of the cocktail party preceding the dinner at the Statler Hotel, the evening of June sixth.

★ ★ ★

**The** Committee desires to acknowledge and thank the following companies for their gracious courtesy in this regard:

**Bethlehem Pacific Coast Steel Corp.**
**The Colorado Fuel & Iron Corp.**
**Columbia-Geneva Steel Division of United States Steel Corp.**
**K. H. Davis Wire & Cable Corp.**
**Planett Manufacturing Co.**

**The** Committee also extends its thanks to **E. Jefferson Crum** of the **R. H. Miller Company** for providing an accordionist, **Dorothy Ray,** to entertain members and guests during the cocktail party and the dinner.


**ROLLER BEARING**

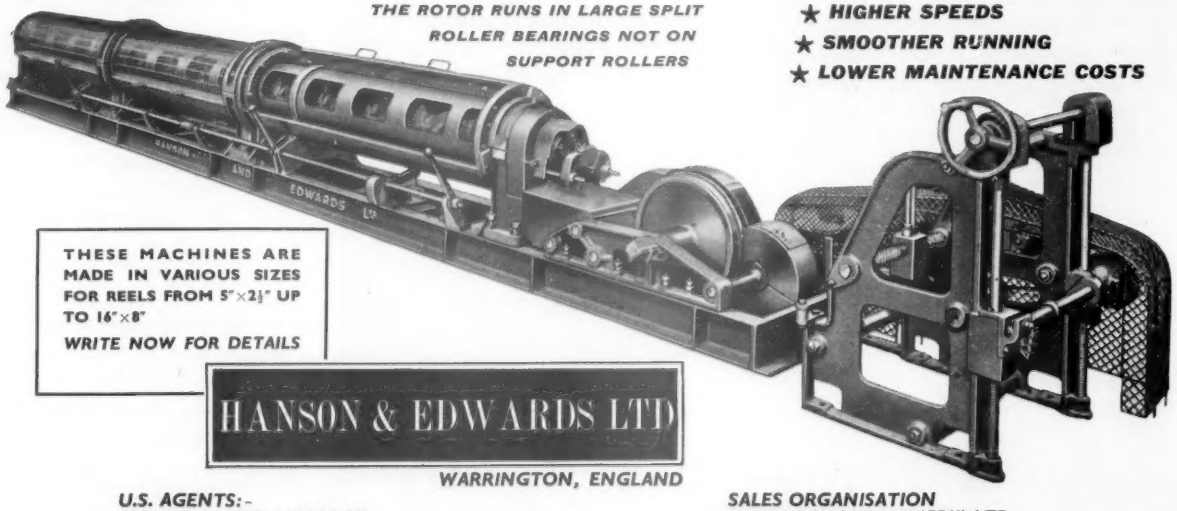
**TYPE TUBULAR**

**STRANDING MACHINE**

**(EITHER SINGLE OR DOUBLE CAPSTAN)**

*THE ROTOR RUNS IN LARGE SPLIT ROLLER BEARINGS NOT ON SUPPORT ROLLERS*

★ *HIGHER SPEEDS*
★ *SMOOTHER RUNNING*
★ *LOWER MAINTENANCE COSTS*




THESE MACHINES ARE MADE IN VARIOUS SIZES FOR REELS FROM 5"×2½" UP TO 16"×8"
*WRITE NOW FOR DETAILS*

HANSON & EDWARDS LTD
*WARRINGTON, ENGLAND*

*U.S. AGENTS:-*
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*LONDON, W.1.*

*P 1686*

EXACTOR MEASURING MACHINES ARE USED BY THE BRITISH GENERAL POST OFFICE

ACTUAL SIZE OF COUNTER FIGURES

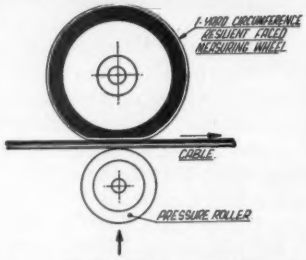
Patents: British 720,597
U.S.A. 2,706,857

# THE 'EXACTOR' CABLE AND WIRE Measuring Machine

**Fitted with the Patented "Resilient-Faced" Measuring Wheel**

**Ensuring Even GREATER Accuracy Than Before!**

LARGE CONTACT AREA— REDUCTION OF SLIP.




**PLUS**

Special ALBION 5-figure reset REVOLUTION COUNTER with ½ inch high numerals for quick and easy reading. Counter records in increments of 3 inches and yards and can be supplied as a *separate* item.

- Straightening device and compound removers fitted for cable.
- Elegant design—robustly built.
- Self-lubricating bushes and ball-races fitted — no manual lubrication necessary.

**FOR ELECTRIC WIRES AND CABLES, ROPES AND FLEXIBLES UP TO 1 INCH DIAMETER.**

**B. & F. CARTER & CO., Ltd.** Bolton, England Telegrams: 'Braiders Bolton.'

ELECTRIC CABLE, BRAIDING AND WIRE ROPE MACHINERY OF EVERY DESCRIPTION

**A RECENT NORTHAMERICAN INSTALLATION OF A SCOURING AND POLISHING PLANT WITH AUTOMATIC DUST AND SCRAP REMOVING.**

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Willowdale, Ontario, Canada
*for Canada and U.S.A.*

## A. MENGERINGHAUSEN NACHF. KG.,

ISERLOHN • GERMANY

## Plasticized Poly(Vinyl Chloride) for Retractile Cords

(*Continued from page* 1217)

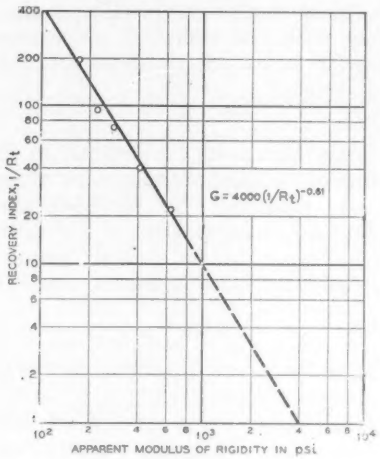


FIG. 6
RELATION OF RECOVERY RATE TO THE APPARENT MODULUS OF RIGIDITY

sal relationship, however, appears to exist between the modulus and recovery of plasticizer systems in general, which again confirms the work of Aiken et al,[1]. For example, samples 6-58, 17-55, and 20-55 plasticized with diisodecyl adipate, Polyester "Z", and 2-ethylhexyl diphenyl phosphate have essentially equivalent moduli (300-320 psi), while their recovery indices are 24, 92, and 182, respectively.

### Effects of Extension Time

As previously pointed out vinyl plastics are not ideal elastic bodies but assume a temporary "set" with time. In vinyl springs this is reflected by a loss in recovery rate and a relaxation in the force exerted. Experimental results on helices illustrating loss in recovery are given in Table VIII and Figure 7. Data on other samples illustrating force relaxation are shown in Table IX and Figure 8. Since the percentage change in recovery and force is of the same order for the

FIG. 7
EFFECT OF EXTENSION TIME ON RATE OF RECOVERY 23°C

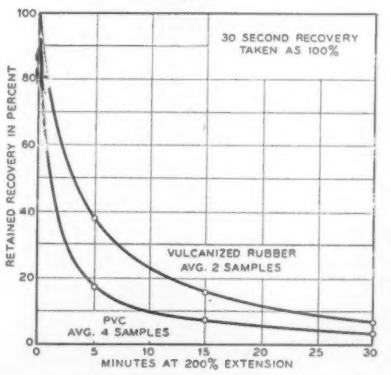
30 SECOND RECOVERY TAKEN AS 100%
VULCANIZED RUBBER AVG. 2 SAMPLES
PVC AVG. 4 SAMPLES
RETAINED RECOVERY IN PERCENT
MINUTES AT 200% EXTENSION

Table VIII

EFFECT OF EXTENSION TIME ON RATE OF RECOVERY AT 23°C

| Sample Designation | Plasticizer 66.6 phr | Recovery Index, $(1/R_t)$ 0.5 min. | 5.0 min. | 15 min. | 30 min. |
|---|---|---|---|---|---|
| 4-58 | Dibutyl Sebacate | 241 | 43 | 15 | 8.7 |
| 3-58 | Di-2-ethylhexyl Sebacate | 63 | 8.3 | 4.8 | - |
| 378-57 | Diisodecyl Phthalate | 53 | 7.7 | <5.0 | - |
| 14-55 | Polyester "X" | 36 | 3.8 | <5.0 | - |
| 57-150 | Neoprene | 329 | 105 | 47.5 | 27 |
| 40-34 | Natural Rubber | 504 | 188 | 112 | 47.6 |

Table IX

EFFECT OF EXTENSION TIME ON RETAINED FORCE (23°C)

| Sample Designation | Plasticizer 66.6 phr | Force in grams at 100% Extension Initial | 2 min. | 10 min. | 20 min. | 30 min. |
|---|---|---|---|---|---|---|
| 337-57 | 1:1 Blend, DOP plus Polyester "Z" | 46.3 | 38.7 | 34.9 | 33.8 | 31.9 |
| 357-54 | 1:1 Blend, DOP plus Epoxidized Soya Oil | 53.0 | 42.6 | 39.6 | 37.9 | 37.0 |
| 19-55 | Polyester "X" | 68.1 | 51.1 | 50.8 | 46.1 | 42.2 |
| 15-55 | Tricresyl Phosphate | 27.4 | 22.8 | 21.8 | 20.6 | 20.1 |


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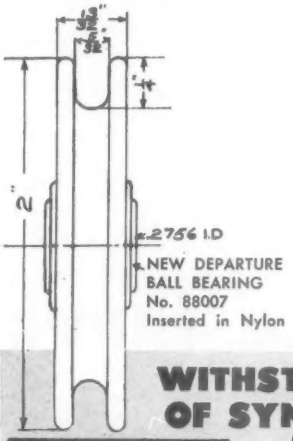


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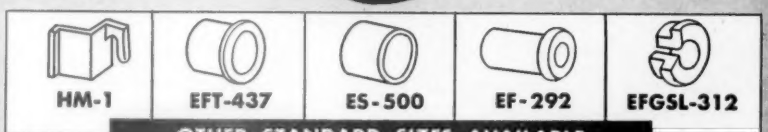


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various vinyls, irrespective of initial levels, an average curve has been chosen in each case to represent the data. In view of the similarity of the results obtained with the various samples, there does not appear to be much hope of altering time dependence through formulation. In choosing a jacketing material for retractile cords, therefore, the apparent best practice would involve starting with a material having the fastest possible initial recovery consistent with other properties.

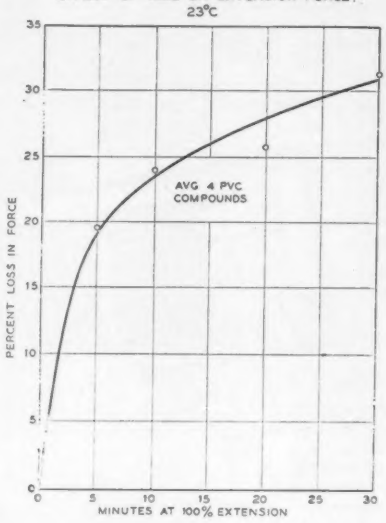
## Conclusions

A helical test specimen has been found useful for investigating the elastic properties of nonrigid poly (vinyl chloride) plastics. Procedures using the helix have been developed for determining a recovery index and an apparent modulus of rigidity.

★ ★ ★

Of the plasticizer and resin components of a vinyl plastic, only the plasticizer was found to affect elasticity significantly. No appreciable difference could be found among resins representing the full range of molecular weights commercially available. The choice and concentration of plasticizer, however, have a marked effect on elasticity, with monomeric types offering a wider choice of properties than do polymerics. The elasticity obtained with phthalate, phosphate and straight chain aliphatic plasticizers appears to be largely a function of the esterifying alcohol with the order of preference being butyl, di-2-ethylhexyl and diisodecyl.

FIG. 8
EFFECT OF TIME ON EXTENSION FORCE. 23°C




★ ★ ★

An exponential relationship is found to exist between recovery and modulus for compositions varying in percentage of the same plasticizer system, but no general relationship is apparent for all plasticizers.

★ ★ ★

Under normal conditions vinyl plastics recover completely after deformation, but the rate and force with which this recovery occurs decrease with the duration of loading, reflecting the influence of the viscous component of these retarded elastic systems.

## Literature Cited

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(2) Alfrey, Jr., T., "Mechanical Behavior of High Polymers," pp. 54-57, Interscience Publishers Ltd., N. Y. (1948).
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## Preheating Conductors in Extrusion Insulating Processes by Copper Loss Method—Temperature as a Function of Current

(*Continued from page* 1213)

of the wire material by

$$r_0 = \frac{\rho_0}{A}$$

★ ★ ★

Using these last two relations in (A-9) and manipulating the resulting expression somewhat ultimately leads to the formula

$$I = A\sqrt{\frac{CV\delta}{\alpha\rho_0 L}\ln(1 + \alpha\triangle T)} \quad \text{(A-10)}$$

which is the same as Equation (3).

★ ★ ★

To obtain Equation (6), it is merely necessary to write

$$I = I_0 \sin \omega t$$

in (A-4) and integrate the resulting differential equation. This is not done here.

## Reynolds Appoints Extrusion Manager

**Appointment** of **William R. Comber** as manager of **Reynolds Metals Company's** aluminum extrusion plant at Grand Rapids, Mich., was announced by **Lester H. Graves**, general manager of Reynolds extrusion division.

★ ★ ★

**Mr. Comber** joined Reynolds in March of this year. Previously he was director of engineering and divisional works manager of the Mallory Battery Company of Cleveland, Ohio; factory manager of the Champion D. W. Machine Company, Erie, Pa., and production manager of the Bendix-Westinghouse Air Brake Company, Elyria, Ohio.

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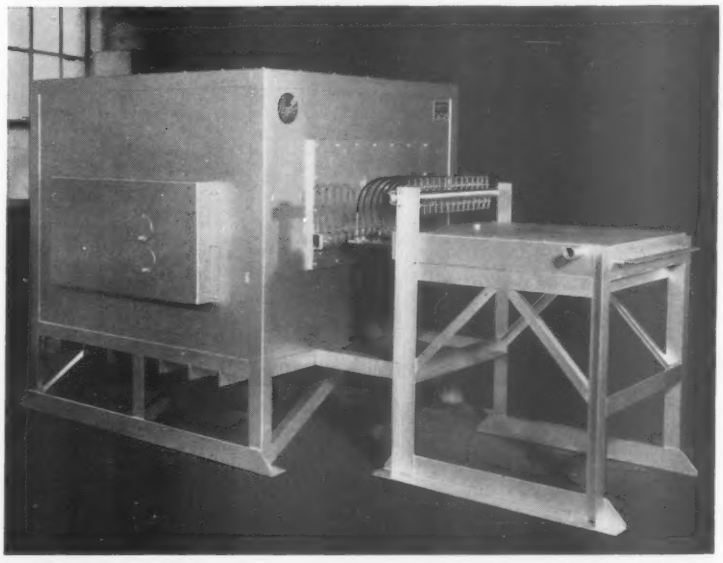

Operating at temperatures from 2000°F. to 2200°F., this 30 tube Harper Electric Strand Annealing Furnace turns out Type 304SS wire bright and clean. Sizes from .02″ to .0014″ are passed through its 40″ hot zone at rates up to 100 FPM per tube.

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ELECTRIC FURNACES

ALUMINUM INGOT AND MILL PRODUCTS AND MAGNESIUM MILL PRODUCTS: JUNE 1958

(Shipments and receipts are in thousands of pounds)

| Item | Number of companies reporting shipments | June 1958 | | | May 1958* net shipments | June 1957 net shipments |
|---|---|---|---|---|---|---|
| | | Gross[1] shipments | Receipts[2] | Net[3] shipments | | |
| ALUMINUM PIG AND INGOT, TOTAL | 88 | 157,588 | 81,879 | 75,709 | 66,148 | 94,068 |
| ALUMINUM MILL PRODUCTS, TOTAL | 156 | 252,262 | 23,675 | 228,587 | 217,299 | 228,081 |
| Sheet and plate, non-heat-treatable | 30 | 103,100 | 19,110 | 83,990 | 81,802 | 81,265 |
| Sheet and plate, heat-treatable | 4 | (D) | (D) | 19,830 | 18,119 | 21,566 |
| Foil, including foil in lamination | 14 | (D) | (D) | 14,947 | 15,739 | 14,301 |
| Rolled, and continuous cast, rod and bar[4] | 5 | 8,555 | 3,489 | 5,066 | 4,810 | 9,690 |
| Wire, bare, conductor and nonconductor | 16 | 3,782 | 183 | 3,599 | 3,107 | 4,226 |
| ACSR and aluminum cable, bare | 11 | (D) | (D) | 16,034 | 16,043 | 15,507 |
| Wire and cable, insulated or covered | 13 | (D) | (D) | 3,975 | 3,401 | 4,057 |
| Extruded shapes, soft alloys | 98 | 62,855 | 747 | 62,108 | 54,750 | 57,569 |
| Extruded shapes, hard alloys | 7 | 4,250 | ... | 4,250 | 3,835 | 5,150 |
| Drawn tube, soft alloys | 13 | 5,563 | ... | 5,563 | 6,680 | 4,564 |
| Drawn tube, hard alloys | | | | | | |
| Welded tube, non-heat-treatable | 8 | 2,659 | ... | 2,659 | 2,111 | 2,159 |
| Powder and paste | | | | | | |
| Atomized and grained powder | 3 | 687 | ... | 687 | 525 | 707 |
| Flaked powder | 5 | 237 | ... | 237 | 298 | 485 |
| Paste | 5 | 1,524 | ... | 1,524 | 1,566 | 1,438 |
| Forgings (including impact extrusions) | 16 | 4,118 | ... | 4,118 | 4,513 | 5,397 |
| MAGNESIUM MILL PRODUCTS, TOTAL | 10 | (D) | (D) | 1,709 | 1,443 | 1,881 |

*Revised.

D Withheld to avoid disclosing figures of individual companies. These figures are included, however, in the appropriate total.

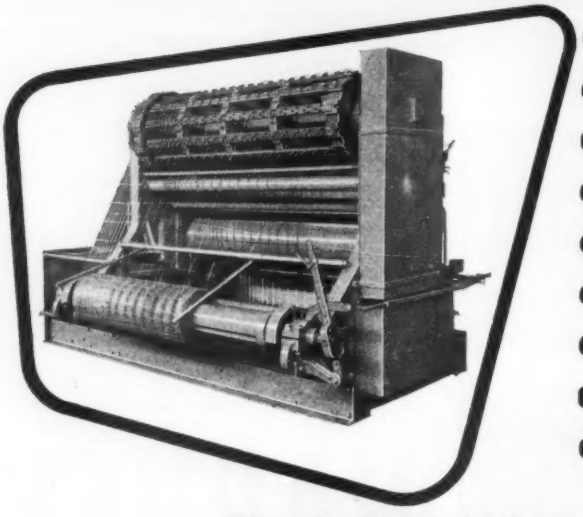
[1]Gross shipments of mill products represent total shipments by producers to customers, including other producers, and shipments by producers to their own fabricating departments which manufacture products beyond the level of mill shapes. Ingot gross shipments include shipments by importers.

[2]For mill products, represents receipts from domestic producers only. In addition to receipts from domestic producers, 198,000 pounds of mill shapes were received through imports. For ingot, receipts from imports are included.

[3]For mill products, derived by subtracting the sum of producer's domestic receipts of each mill shape from the industry's gross shipments of that shape. Ingot data derived by subtracting all receipts from shipments reported.

[4]Includes a small amount of rolled structural shapes.


Interlocking FENCE LOOMS



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COPPER - Consumption of refined copper in the United States, May-June 1958, in short tons

| | Wire mills 1/ | Brass mills 2/ | Chemical plants | Secondary copper smelters | Foundries and miscel-laneous | Total |
|---|---|---|---|---|---|---|
| May: | | | | | | |
| Cathodes | 303 | 6,444 | (3) | 43 | (3) | 6,790 |
| Wire bars | 48,190 | 3,484 | (3) | ----- | (3) | 51,674 |
| Ingots and ingot bars | 686 | 3,192 | (3) | 172 | (3) | 4,050 |
| Cakes and slabs | ----- | 8,705 | (3) | 2 | (3) | 8,707 |
| Billets | ----- | 10,331 | (3) | ----- | (3) | 10,331 |
| Other | 91 | ----- | (3) | 26 | (3) | 117 |
| Total | 49,270 | 32,156 | (4) | 243 | (4) | 4/84,669 |
| June: | | | | | | |
| Cathodes | 353 | 7,620 | (3) | 24 | (3) | 7,997 |
| Wire bars | 63,905 | 2,984 | (3) | ----- | (3) | 66,889 |
| Ingots and ingot bars | 785 | 4,862 | (3) | 261 | (3) | 5,908 |
| Cakes and slabs | ----- | 8,236 | (3) | 2 | (3) | 8,238 |
| Billets | ----- | 14,314 | (3) | ----- | (3) | 14,314 |
| Other | 60 | ----- | (3) | 38 | (3) | 98 |
| Total | 65,103 | 38,016 | (4) | 325 | (4) | 4/106,444 |

1/ Includes all wire mills with rod-rolling facilities. 2/ Includes all brass mills using copper in refinery shapes; some have rod-rolling facilities. 3/ Not available. 4/ Consumption by chemical plants, foundries, and miscellaneous plants not included. Estimate of 3,000 tons included in total.


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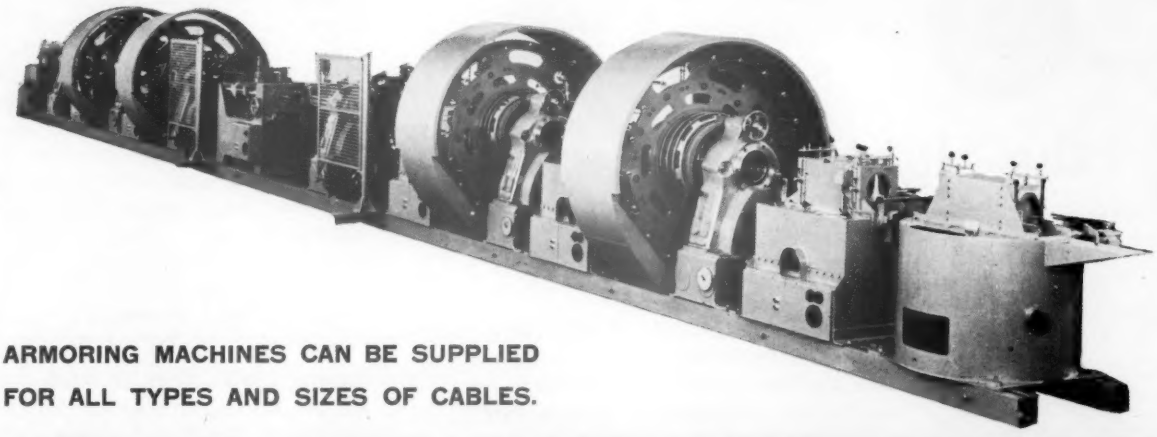

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## Zinc Protects Bridge Cables for Over 75 Years

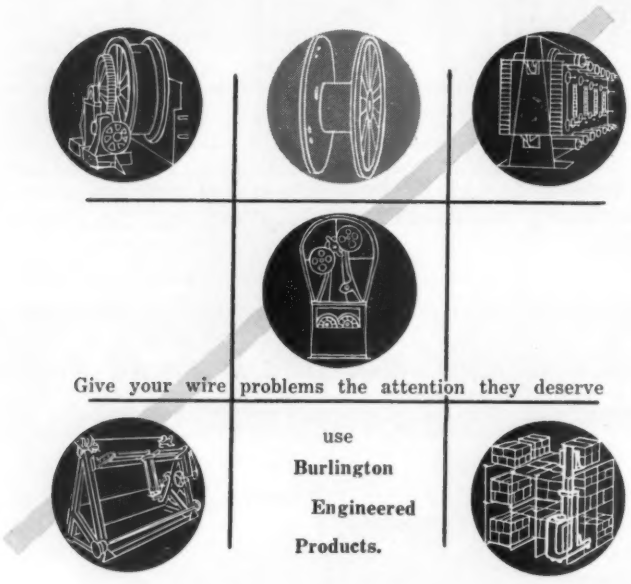
**Seventy-five** years of continuous service in the corrosive salt water atmosphere characteristic of New York City have caused no serious impairment to the giant 15¾ inch galvanized wire cables that support the Brooklyn Bridge, according to a report from New York City Department of Public Works Commissioner **Frederick H. Zurmuhlen.**

★ ★ ★

**To** preserve and extend the usefulness of the historic Brooklyn Bridge, periodic examination and testing of the galvanized wire cables of the 75-year-old span is essential, and this has revealed that the galvanized wire still is in good condition and should remain serviceable for many more years.

★ ★ ★

"Relatively rough methods of wire manufacture at the time these cables were installed were believed might have caused non-uniform depths of the galvanizing, yet there are no indications of serious impairment to the outer wires of the main cables," said the Commissioner.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## New "Flexolon" Wire Bulletin

**A** new bulletin offered by **Tensolite Insulated Wire Co., Inc.,** describes an extensive series of tests performed to illustrate advantages of new Flexolon hook-up wire over wires of other construction. Individual tests were run on a sufficient number of random samples of Flexolon wire and other types, selected from large lot sizes, to assure that results obtained were truly representative of extended manufacturing runs. The various samples were tested for flexibility, dielectric strength, concentricity, and average length. Tests are fully described and charts and graphs are included. For a free copy of Flexolon wire bulletin, write to Tensolite Insulated Wire Co., Inc., West Main Street, Tarrytown, New York.

## Submerged Arc and Inert Gas Welding Wire

**An** informative and information-packed 4-page folder, describing Page Automatic Welding Wire for inert gas and "submerged arc" welding processes, has been issued by the **Page Steel & Wire Div., American Chain & Cable Company, Inc., Monessen, Pa.**

★ ★ ★

**Designated** as bulletin DH-402B, it contains packaging data for the welding wires which are available in reels, coils, straight lengths, pallets, and in payoffpaks. In addition, the bulletin gives complete and up-to-date analyses of the various Page stainless steel, low alloy and mild carbon steel welding wires.

## Steel Statistics

**The American Iron & Steel Institute,** 150 E. 42nd St., New York 17, N. Y., has published the 1958 edition of "Charting Steel's Progress," a graphic book of facts on the industry.

★ ★ ★

**Divided** into 6 chapters, it covers materials used in steel making, steel making capacity, growth in steel production, distribution of

finished products, hours and wages, and the industry's financial status.

★ ★ ★

**Copies** are available from AISI upon request.

### To Handle Wemco Pumps

**Wire Equipment Manufacturing Co.,** Trenton 10, N. J., has appointed **McConnell Sales & Engineering Corp.,** 1661 28th St., Birmingham 9, Ala., to handle the sale of Wemco Molten Metal Pumps in the South.

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**Wemco** pumps are used for the transfer of molten zinc, lead, tin, aluminum, heat treating salts and other materials.

### Fast Heating Combustion System

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**The A. F. Holden Co.,** 380 Hilton Rd., Detroit 20, Mich., has found an answer with its new luminous wall firing or "instantaneous heat" system.

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**The** firing system is a method of applying instantaneous heat uniformly to a part to be treated. It provides a positive source of transferring heat by radiation directly to work processed. However, during heat transfer, the thermal storage in the furnace structure is negligible. This feature of the system results in the unique combination of rapid starting, rapid cooling, and rapid restarting.

★ ★ ★

**For** example, Holden reports that during a recent test a solid 2-inch cylinder of iron, 6 inches long, was heated from 80° F. to 2000° F. in less than 20 minutes and was cooled back down to 1000° F. in 16 minutes while still in the furnace by means of controlled, continuous air flow through the porous refractory lining. Less fuel is consumed and refractory life is extended.

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**Used** in a wide range up to 2300° F., the combustion system is particularly applicable in a variety of specialized application areas where speed of heating and uniformity of heating are important.

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### Firth Sterling Announces Two Promotions

**Firth Sterling** announces the promotion of **J. Mabon Childs** and **Stephen F. Madden** to Assist Managers, Steel Sales Division. Mr. Childs will be responsible for the sales of high speed steel, tool bits, drill rod, ground flat stock, and shank steel. In addition, he will continue to manage the sale of Zirconium Alloys. Mr. Madden will be in charge of Tool and Die Steel sales, and will continue in his present capacity as Metallurgical Engineer.


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(ESTABLISHED 1939)

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## Polyethylene in Power Cables

(*Continued from page* 1210)

**These** installation procedures together with cable of the proper design and manufacture should result in a distribution cable which will perform with the dependability and excellence which have been characteristic of polyethylene ever since its participation in World War II. And polyethylene will not rest content with its honors. Improvements in the material continue to be made and the end of possible applications is not yet in sight.

★ ★ ★

**The** development of new high-density polymers by the so-called "low pressure" process is a technological break-through of major proportions. A whole range of polymers having various crystalline-amorphous ratios are being evaluated for wire and cable applications, and some of these materials have shown high promise for power cable. While not supplanting the older polymers, the high density materials offer substantial improvement in some of the properties that have always been desired by wire and cable engineers and manufacturers. The result should be a greatly expanded use of polyethylene in all types of power cable.

★ ★ ★

**The** high-density materials possess a lower coefficient of volumetric expansion over the useful operation range for wire and cable applications. This means that in applications where temperature cycling and subsequent expansion and contraction are encountered, the high-density materials give less difficulty than with previous polyethylenes.

★ ★ ★

**The** high-density polymers deform to a much lesser degree at equivalent temperatures, retain strength and stiffness at higher temperatures, and expand to a lesser degree than lower density polyethylenes. These properties are significant in applications such as power cable where, it has been found, momentary overloads and concomitant high temperatures are likely to occur.

★ ★ ★

**The** physical and electrical properties of the high-density polymers show that they are suitable materials for both insulating and jacketing applications. The new polymers have better deformation resistance, which is desirable for multiconductor assemblies where deformation problems are often encountered. It is quite likely that high-density polyethylene will find extensive use as a jacketing material over lead.

★ ★ ★

**Power** cable designs using high-density polyethylene insulation are already past the drawing board stage and are ready for installation. Performance data will, therefore, not be far behind. Much remains to be explored in the service behavior of the new polyethylene

polymers, but our experience thus far with polyethylene for power cables gives us ample cause to say that the new polyethylenes will enhance the superb reputation of this truly ideal wire and cable insulating material.


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Send for booklet describing its activities and a membership application card.

453 Main St. Stamford, Conn.


## Pressure Lubrication of Wire Drawing Dies—A Practical Application

(*Continued from page* 1205)

thus preventing distortion, the phenomena of pressure lubrication, which immediately presented itself, was the added feature. It was discovered that by using a guide plug having a bore size about 10 to 15% larger than the entering size of the rod or wire and thus allowing ample clearance for the lubricant, in this case dry soap powder, to enter the drawing zone of the die, a pressure of 800 to 900 pounds per square inch was created. This force can be increased by reducing the bore size of the guide plug. Due care must be exercised however as the pressure builds up rapidly and may fracture the entire unit.

★ ★ ★

**Interchangeable** carbide guide plugs are stocked and supplied to our machines in bore sizes from .100″ to .300″ in increments of .025″ for the smaller types of these holders. The larger sizes are furnished with a bushing made from hardened tool steel and are provided with a protruding hexagon head for ease in assembly.

★ ★ ★

**Our** records show that by the use of these pressurized die holders (see Figure 3), die-life is increased by approximately 20% and distortion of wire during drawing operations is entirely eliminated. In dry drawing of certain clad rods these holders have proved to be indispensable. From a rather humble start 25 years ago until today with nearly 300 of these units in daily use, they have proved to be of great value in the production of high quality wire.

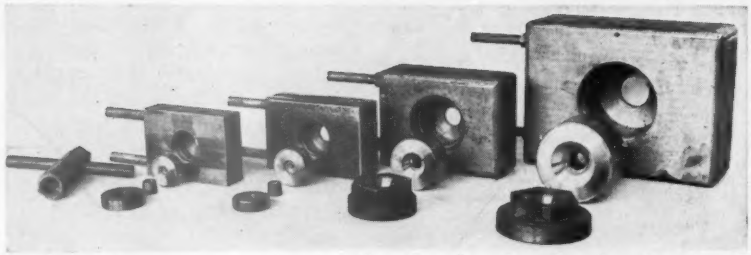
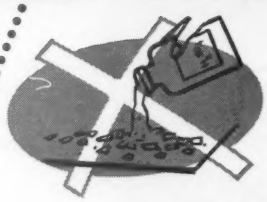


Figure 3.


**STANNOUS SULFATE . .**

**A PREPARED chemical of UNIFORM quality for LIQUOR FINISHING**



*ELIMINATES haphazard preparation*

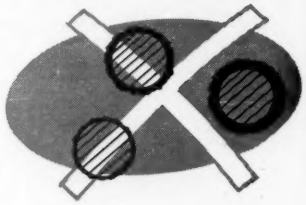
—Standard stock solutions are easily and quickly made up in advance . . . stannous sulfate composition is known, and is uniform from batch to batch.

*ELIMINATES complex control*

—there are only two simple ingredients to control . . . color adjustment is quick and simple and may be made immediately.

*ELIMINATES uneven quality*

—tin content is divalent, the only form suited for iron replacement reaction . . . tin coatings are smooth and uniform, and of pre-determined thickness.



*ELIMINATES unnecessary costs*

—replaces needless processes, saves tin and copper, saves on time and labor, improves quality of tin coating.

*Write for detailed information.*

TIN & TIN CHEMICALS
CERAMIC MATERIALS
ORGANIC COATINGS
WELDING SUPPLIES
PLATING MATERIALS
METALS AND ALLOYS
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### Allen Advanced by Sheet & Tube

**Robert W. Allen** has been appointed assistant superintendent of the company's Struthers, O., Merchant Mills, **Youngstown Sheet & Tube Company** district manager **E. O. Reese** announced.

★ ★ ★

**Mr. Allen** had for the past six years been general foreman of the Strip Mill Roll Shop.

### X-Rays Help Maintain Steel Quality

**X-ray** diffraction and spectrographic equipment is serving as a valuable aid in the development and production of top quality strip and tubing, according to a recent statement by **J. W. Wilton,** Chief Metallurgist, **Wallingford Steel Company,** Wallingford, Conn.

★ ★ ★

**In** the company's research and development program, X-ray units have been used to solve important problems for years. Now, the instruments are vital in making routine tests of material for the Quality Control Department. Wallingford pioneered this application of X-ray in the steel industry to assure optimum composition and structure in its products to meet all customer requirements.

★ ★ ★

**The** Metallurgical Department uses X-rays to determine the exact chemical makeup of each coil of steel or alloy and reports the results to the Quality Control Department. Additional "type checks" are made with X-rays on coils after various processing stages. The Norelco X-ray Spectrograph is used to determine percentages of iron, chromium, nickel, manganese, molybdenum, titanium, columbium, cobalt, copper and all essential elements, except carbon, which is checked by combustion methods.

★ ★ ★

**In** processing certain metals, forming characteristics and preferred orientation can be correlated to provide effective quality control. Wallingford Steel uses X-ray diffraction to establish correct processing in order to obtain the desired orientation. Once plant procedure is set up, the same X-ray methods are employed to evaluate finished material in routine quality control tests.

### National Machinery and J. G. Kayser Merge

**J. G. Kayser,** Machinery Works, Nuremberg, Germany, has been merged with **The National Machinery Co.,** Tiffin, Ohio, U.S.A. The firm is well known in industry as manufacturers of machinery for the cold forming of screws, while The National Machinery Co. is well known throughout the world for its "Boltmaker." This firm also specializes in machines for nut production and hot forming of screws and similar parts.

★ ★ ★

**On** the occasion of the amalgamation, **Dr. Henry Fuld,** hitherto sole proprietor of J. G. Kayser, has


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ENGLISH WIRE

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YOUR DEPENDABLE SOURCE FOR WIRES OF ALL KINDS, INCLUDING:

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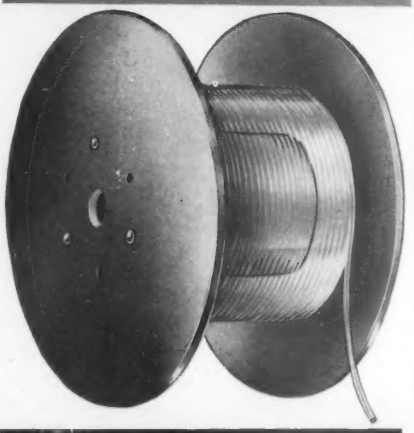

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- Low freight charges for tare weight.
- No bookkeeping costs.
- No handling or storage problems.
- Tubes recessed into flange and firmly cemented into place.
- Customer's name or Trade-Mark can be molded into the flange, at no extra cost.

IF YOU ARE FACED WITH A WIRE SPOOL PROBLEM WRITE, PHONE OR WIRE US FOR IMMEDIATE ACTION

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retired. Dr. Fuld recently celebrated his 70th birthday, and it was under his direction that his firm made remarkable progress, especially during the last ten years. Having been converted to a limited company, the company remains otherwise unchanged, and it will in future be known as **J. G. Kayser GmbH.**

★ ★ ★

**Dr. Wolfram Grassegger,** B. Comm., Nuremberg, has been appointed Managing Director.

## Alcoa Display of Aluminum in Electrical Applications

**Visual** evidence of the growing ascendency of aluminum in the electrical field was presented in a display that overflowed the spacious Alcoa Building lobby in September.

★ ★ ★

A technical information exhibit of aluminum applications in the electrical industry — which has been predicted as potentially the largest market for aluminum — began a three-day stand in Pittsburgh, timed to the 1958 Annual Meeting of the Pennsylvania Electric Association.

★ ★ ★

**The** display will move back into the Alcoa Building on October 26, to run through October 30, during the 1958 Fall General Meeting of the American Institute of Electrical Engineers, to be held here during that week.

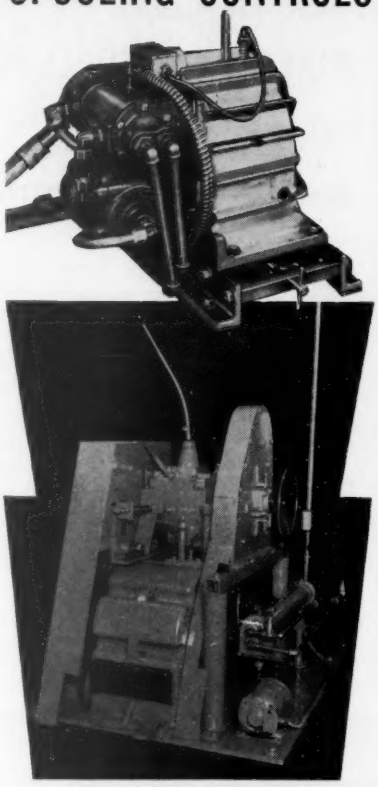
## Booklet Describes Control Cable Constructions

A new four page booklet describing Triangle Control Cables, the various constructions available as well as suggested applications, is offered by **Triangle Conduit & Cable Company, Inc.,** New Brunswick, New Jersey.

★ ★ ★

**The** booklet lists the various sizes of control cables and describes the sheaths and insulations used — several of which were developed especially by Triangle for this application.


**TENSION AND SPOOLING CONTROLS**



Illus.: Unit in operation on 75HP Capstan Holdback.

Tensolite, Anaconda, Plastoid, National Standard, Johnson Steel & Wire, Pittsburgh Steel, Boston Insulated Wire, Worcester Wire and a host of other wire producers found out that for successful SPOOLING
DRAWING
COATING
TINNING
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**there is no equal to the 'FRANKEL'**

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Proven Best For Web & Filament Machinery Since 1934

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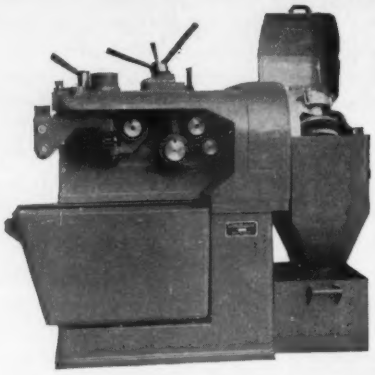

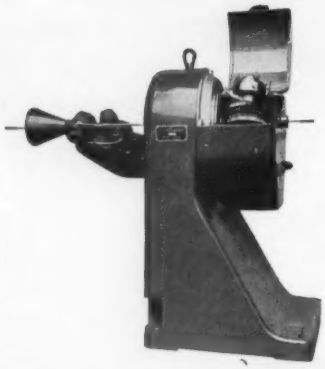

Hundreds of these machines are giving excellent records in low cost effective dry cleaning of hot rolled steel wire rods—here and abroad!

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## Some Recent Applications of High Density Polyethylene

(*Continued from page* 1204)

high- and low-density polymers. Test specimens used consisted of #14 AWG bare copper insulated with a 1/32-inch wall of polyethylene. The wire sample was wrapped around itself in a series of close wraps and tested in an air oven at 70 deg. Centigrade. Since 70-85 deg. C. are common maximum operating temperatures in practice, there seems every indication from the data that new high-density materials should perform as well as low-density materials under equivalent conditions of stress.

★ ★ ★

It must be recognized that some of the properties of the high-density polyethylenes will be the same as for low-density polyethylenes. For example, they will have essentially the same burning characteristics. The same excellent weathering characteristics now enjoyed with standard polyethylene can also be obtained by the addition of carbon black in the same proportions to high-density materials. Such electrical properties as dielectric constant and dissipation factors, are essentially of the same order of magnitude for both high- and low-density polymers. Dielectric constant, however, is slightly higher for the high-density material, as would be expected from the increased density. Typical electrical property data are presented in Table VI.

### Conclusion

Essentially the high-density polymers offer the wire and cable manufacturers tougher, more rigid, abrasion resistant extrusion materials. These polymers also have the virtue of higher deformation temperatures which serve as safety factors. The newest of the high-density compounds, DGDA-5100, offers all of the advantages of conventional high-density materials, plus improved thermal embrittlement resistance, improved abrasion resistance, and improved cut-through resistance. In fact, this

newly developed compound represents the ideal compromise between the aforementioned properties and the excellent extrudability desired by most manufacturers.

* * *

**From** a laboratory curiosity to a commercially available resin, polyethylene has earned an excellent reputation for its performance in serving the wire and cable industry. The future for polyethylene and the polyolefin polymers which are yet to come, is encouraging. With the diversification found in properties of polyolefins covering an ever-widening density spectrum, these new materials are finding new and increasing applications and markets in all phases of the wire and cable industry.

## Polyethylene for Overhead Line Wire

(*Continued from page* 1200)


2. KABELITEMS No. 84, "Comparison of the Mechanical Properties of Polyethylene and Polychloroprene," September, 1955.
3. KABELITEMS No. 88, "BAKELITE Polyethylene Line Wire Covering," February, 1956.
4. "Symposium on Polyethylene," July, 1952, AIEE Conference Papers.
5. Schatzel, R. A., "Rubber and Plastic Insulation in Cable," Wire and Wire Products, November, 1953.
6. Canavan, W. J., "Polyethylene on Wire" MODERN PLASTICS, February, 1957.
7. McCormack, C. E. and Baker, R. H., "Neoprene Coverings for Weatherproof Wire," Wire and Wire Products, October, 1953.


## Steel Pails for Magnet Wire

**By** using magnet wire packaged in specially-designed steel pails instead of on spools, Fasco Industries, Inc., Rochester, N. Y., has cut many thousands of dollars from annual manufacturing costs of field windings for fractional horsepower electric motors in its well-known lines of fans, evaporative coolers, and ventilators. It is estimated that savings in wire-handling costs alone amount to $15,000 to $20,000 annually. Probably most important is the fact


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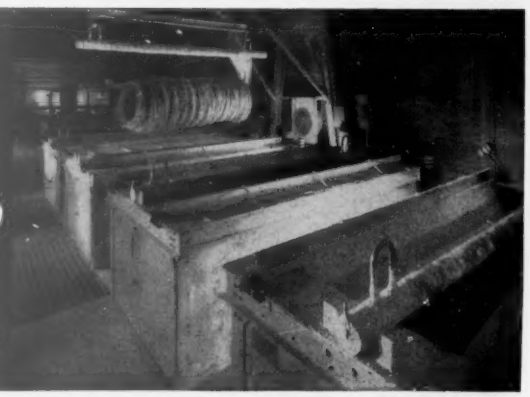
HI-SPEED REGISTERED
ROD BAKERS



Faster baking, greater fuel economy, maximum production efficiency are just a few of the results of the exclusive heating arrangement of the Carl Mayer Hi-Speed Rod Baker. It also has a patented blow-off feature which removes moisture without damage to coils.

Here are just a few of our many satisfied customers:

American Steel & Wire Co.
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Colorado Fuel & Iron Corp.
Crucible Steel Co. of America
Driver-Harris Co.
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Republic Steel Corp.
Sheffield Steel Div., Armco Steel Corp.
Steel Company of Canada

*Write for Bulletin No. 350*

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OTHER PRODUCTS: Core Ovens • Mold Ovens • Welding Rod Ovens • Heat Treating Ovens & Furnaces • Special Processing Equipment and Accessories.

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**COMPLETE RECLAIMING SERVICE**

**The DANFORTH PROCESS of reclaiming produces powders that are *guaranteed* to be 99% or better pure.**

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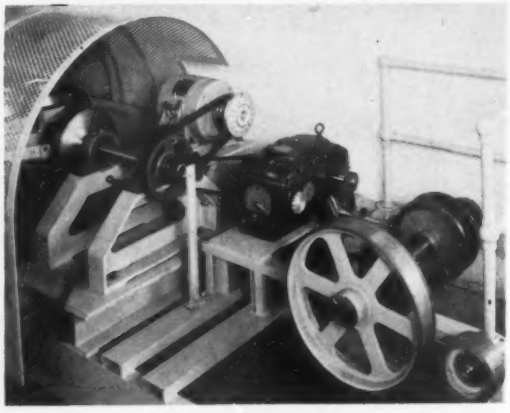
**101 E. Indianola Ave.** Established in 1912 **Youngstown 7, Ohio**



# Edmandsco Wire Twisting Machines



Detail of Capstan Drive of one of our Two-Wire Double Twist Twinning machines.

The variable speed device provides infinite rates of lay within the range of the machine and permits the operator to set the lay easily and quickly.

This is just one of the features, resulting in the extremely high production of quality twinned wires from the Edmandsco Double Twist, Constant Tension Twinning Machines.

**THE EDMANDS CO.**

**860 WELLINGTON AVE.**
**CRANSTON 10, R. I.**


that the steel pails contain ten times longer lengths of wire than can be wound on spools.

★ ★ ★

**Another** important advantage is the elimination of the expensive handling of returnable spools. This involved an investment in deposits on spools, maintenance and handling for returns, and book-keeping records. From $1500 to $2500 annually is saved in book-keeping costs.

★ ★ ★

**Use** of steel pails for wire was made possible by the development of filling methods and of accessory equipment for removing the wire from the pails, at high speed without damage or entanglement. A special steel pail, the Jal-Pak, was developed by **Jones & Laughlin Steel Corporation's** Container Division. Made of 26-gage steel, its two principal features are smooth inside walls and cost low enough to permit discard after use.

★ ★ ★

As a result of recent improvements in "de-reeling" equipment, Fasco can take wire out of Jal-Pak pails at speeds up to 2700 feet per minute when making skeins for multiple speed motors. For the small fractional horsepower motors, the speed ranges from 300 to 450 feet per minute. This corresponds to 700 to 900 strokes per minute of Ft. Wayne winding machines, one of several types in use at Fasco.

### Engineering Changes Announced By Springmaker

**Changes** in the engineering organization of the **Wallace Barnes Division of Associated Spring Corporation,** Bristol, Conn., have been announced by **G. T. Zahnke,** General Manager of the Division.

★ ★ ★

**John B. Beckwith** has been appointed to the new post of engineering manager and **David E. Waite,** chief product engineer, has been assigned to the factory manager's staff to work on special assignments.

## New Design in Non-Returnable Reels Announced

**The Hubbard Spool Division** of the **American Pulley Company,** Garrett, Indiana, has been producing for several months this latest design in nonreturnable shipping reels for the Magnet Wire Industry. This latest design is unique in that it embodies all of the best features of the more expensive returnable type reels and, at the same time is lighter in weight, constructed to precision standards, to enable wire manufacturers to use it with finer gauge wires.

★ ★ ★

**This** new type of construction is extremely accurate and dimension-

ally stable as the result of being constructed with a metal barrel and formed outside metal reinforcing plates so that the reel can be welded together as a permanent, positive assembly.

★ ★ ★

**One** of the outstanding features is the ease of handling due to the deep well formed into the reinforcing steel end cups so that the operator or customer does not have to look for handholes for lifting and can pick the reel up from any position with this built in "positive grip" feature. Another outstanding feature is the hard smooth surface of the flanges which allow high speed take off of fine wire with no risk of snagging or drag.

★ ★ ★

**The** new construction is ideal for palletized shipments due to smooth surface on the outside of the flange. All of the above mentioned advantages are incorporated into

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*Pickling Bath Additives • Mold Lubricants • Corrosion Inhibitors*

*Dry Wiredrawing Compounds • Wet Wiredrawing Compounds*

Look to Nopco next time—every time—you order chemicals for your wiredrawing operations. Remember, with Nopco plants and warehouses strategically located across the nation, you are assured prompt delivery. And remember, too, Nopco has a wealth of technical experience in the application of these chemicals in the wire-drawing industry—has built its business by solving the problems of its customers. Our technical facilities and know-how are, of course, available to you—to help solve your particular problems. Simply write or telephone for complete information today. Nopco Chemical Company, Harrison, N.J.

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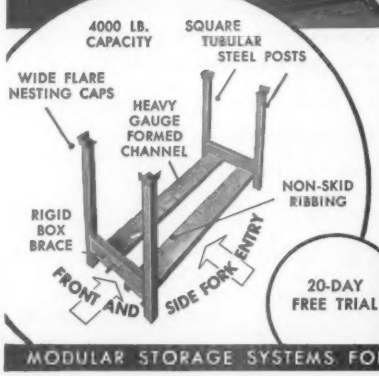
PORTABLE

WIRE COIL RACKS

COURTESY HOLO-KROME SCREW CORP.

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Makes handling and storing of unwieldy wire coils a simple one-man operation. Improves plant housekeeping, saves space, provides positive inventory control. Front and side fork entry permits closer stacking and greater maneuverability in narrow aisles. Saves time, labor, cuts costs. Standard and special sizes.

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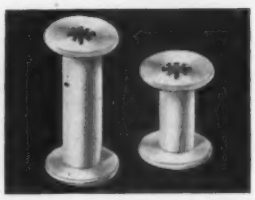

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**WIRE BRAIDERS**

- ACCURATE AND DURABLE
- MADE IN STANDARD 16 AND 24 CARRIER SIZES

**BRAIDER BOBBINS • COP HOLDERS**
**WIRE SPOOLS**

***Protect your wire with "PLAMENCO" for best results.***

WE INVITE YOUR INQUIRIES

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**for Die Sizes**

***Provides quick and accurate information on die sizes and reduction areas.***

***Calculates wire production rates for various speeds and efficiencies.***

***OTHER FEATURES***

- Determines small percentages accurately.
- Reading in B & S gauges.
- Legible % draft-per-hole scale.
- Rectangular back protects calculator.
- Plastic construction resists wear, perspiration warping and dirt.
- Fits in a vest pocket.
- Steel, copper and aluminum lb/ft scale.
- Durable and easy to use.

SAVES TIME, MONEY AND TEMPER

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THE PRICE: $5.00 EACH

*Send orders to*

**WIRE AND WIRE PRODUCTS**

*Exclusive Distributors*

453 MAIN STREET STAMFORD, CONN.


this new design for fast efficient handling of up to 100# of fine wire and sells for under $1.00 each in standard sizes and quantities.

## CF&I's Clinton Wire Cloth to be Moved to Palmer

**The** modernization program of the **Wickwire Spencer Steel Division** of **The Colorado Fuel and Iron Corp.** has resulted in the decision to move the facilities of the Clinton, Mass., plant to the Palmer, Mass., plant location, it was announced by **Alwin F. Franz,** president.

★ ★ ★

**The** move will afford a more centralized control over production in New England and will make possible additional economies plus increased efficiency through use of Palmer's modern facilities for housing the additional new equipment. It is expected, too, that establishing such a single source of production and sales will result in more satisfactory customer service for a wider range of Wickwire products. The move is now in progress and it is anticipated that it will be completed before the end of the year.

★ ★ ★

**The** products which had been produced at the Clinton plant affected by the transfer to Palmer, Massachusetts are Industrial Wire Cloth, Space and Vibrating Screens, Steel Processing Belts, Hardware Cloth, Netting, Overhead Conveying Equipment, Fire Door Hardware and Sliding Door Hardware.

★ ★ ★

**However,** the Clinton, Massachusetts plant will still produce Perforated Metals which will continue to be sold through the Mechanical Specialties Sales Office.

## The Progress of Mechanical Descaling In England

(*Continued from page* 1191)

nomical practice by a number of Wire Manufacturers.

### Comparative Costs

**When** the Mechanical Descaling Machine is substituted for pickling

it virtually cancels all the costs entailed by the Pickling Yard and these are, as we know, very considerable and include acid — lime or substitute — Phosphate coatings— Inhibitors and a maintained heating service, plus handling and direct labour costs.

★ ★ ★

**These** costs can amount to between 40% and 50% of the total cost of producing the Bright Drawn Steel Wire if any subsequent heat-treatment is excluded.

★ ★ ★

**The** Twin-Roll machine has practically no running cost; being driven by the action of the wire passing around the first draw block, the machine has no auxiliary power drive and therefore no power costs.

★ ★ ★

**The** expense of Roll replacements and wiping materials are very small and are in some instances taken care of by the sale of scale collected at the Descaling Machine. This is in the nature of 1½% by weight of the rods processed.

★ ★ ★

**There** is also a saving of prime metal. As compared with the 1½% by weight loss through mechanical descaling, a loss of 2½% is made when pickling, with the type of scale being provided by the Rolling Mills at present. The difference of 1% is caused by the acid attack on the Virgin Metal whilst even scale removal is being achieved.

★ ★ ★

**If** the scale was reduced to below 1% by controlled cooling of the reeling temperatures of the Hot Rolled Rod, the saving would not be so much, as the attack on the Virgin Metal would not be so great with the ensuing shorter pickle time.

★ ★ ★

**It** is estimated that the capital outlay for the Twin Roll Machine is recovered after producing approximately 200 tons.

★ ★ ★

**The** capital outlay for the Multiple Roll Machine is five times as great as that of the Twin Roll Ma-

for . . .

**Nonmetallic**
**Sheathed**
**Cable . . .**

a patented paper which is highly water repellent and available in all weights both creped and flat . . .

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**PLYWOOD • MASONITE**
**FOR ELECTRIC CABLE, WIRE AND WIRE ROPE**
**LOW IN PRICE • • STRONG AND STURDY**
**MADE IN A FULL RANGE OF SIZES**

**ADVANTAGES**

- Our own plywood mill
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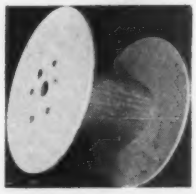

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chine and the requisite production to cover this outlay is approximately 1000 tons.

★ ★ ★

**Roll** changes are in the same way more frequent, as 5 to 6 times more rolls are being used, but brushing and wiping materials need replacing only as often as the Twin Machine.

## Conclusions

**There** is still quite a reluctance to substitute the Mechanical Descaler for the Pickling Yard. Some apathetic tendency towards the change is due to the fact of there being quite a large capital investment already involved in Pickling Plants and until such plant necessitates replacement, no serious changeover to Mechanical Descaling is envisaged, but on the other hand some wire manufacturers, being beset with difficulty in effluent discharge and having to satisfy Local Authority with the neutral value of the spent liquor before discharging, are finding neutralisation a costly procedure and are turning to the use of the Mechanical Descaler to the extent described.

★ ★ ★

**Some** manufacturers have reduced their pickling by 75% and some by 50%, with pickling being used for heat-treated wire only. These wire producers are satisfied with the finish obtained and also the slower speed of production and make the point that for a 25% increase in wire drawing machinery, the pickling yard has been reduced by 50% and this cost in the wire drawing process cancelled.

★ ★ ★

**With** more publication of facts regarding actual productivity results with the Mechanical Descaling method and exchanges of views regarding the problems of the procedure, I feel sure that this method will replace a very large percentage of the Pickling Process and so reduce by a similar large percentage the use of Acids and all the problems of Fabric Maintenance, together with the difficulties involved in disposing of obnoxious scrap effluent.

## A Modern Order Entry and Invoicing System

(*Continued from page* 1188)

livery and customer's order number; approximately 90% of the order is automatically typed by using this tape. On items from an individual customer for which no tape is available a tape for the same product can be used by typing additional variable information. Still approximately 70% of the order can be automatically typed from this teletype tape. It is interesting to note that by rolling this tape and filing in special files, built especially for this purpose, 4500 tapes can be filed in a cabinet the size of a standard three high file cabinet.

★ ★ ★

At the Division Service Center, a teletype tape and order form are received on a tape reperferator and teletype machine. A duplicate number is assigned to the tape and order set. The tape is retained in the teletype room and the order set is routed through the Division Service Center which consists of Sales, Metallurgical Coding, Schedule Clerk and Traffic Department. Copies of the order set are removed as the order is processed through the Division Service Center. After acceptance of the order, one copy of the order set is returned to the teletype room and the corresponding tape attached. If no notations have been added to the order, the original tape received from the District Sales Office is used to transmit the order to the Producing Mill Service Center. The tape and copy are destroyed after transmission. If notations have been added to the order at the Division Service Center, the original tape received is processed through a teletype processing unit and these notations are added and at the same time a new tape is automatically produced which includes the notation added. This reproduced tape is then used to transmit the order to the Producing Mill Service Center. At the time of transmission additional copies are made for internal use at the Division Service Center by having a teletype printer wired into the transmitter. If the Division Service Center has added notations which are to be shown on future


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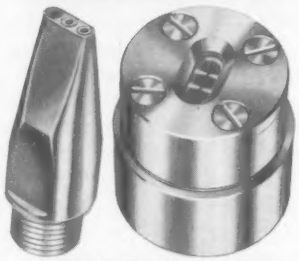

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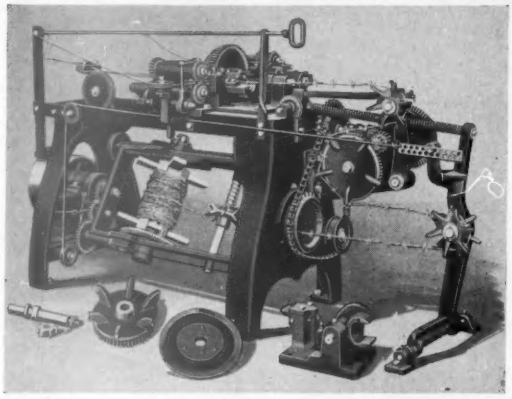

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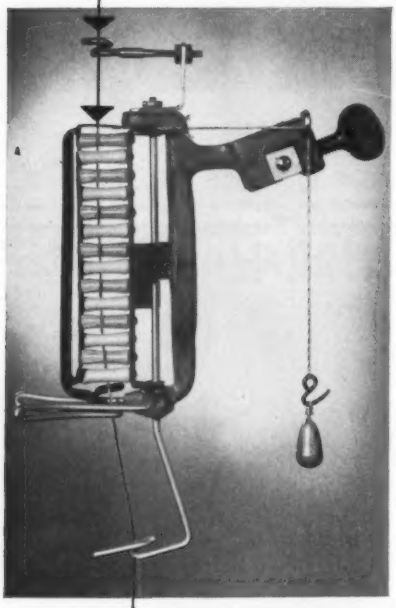

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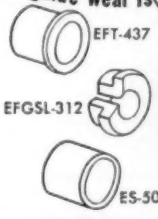


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orders, this tape and corrected copies are returned to the District Sales Office. The tape is filed in place of the tape originally typed for this item and the corrected copies replace the original copies on file at the District Sales Office.

* * *

At the Mill Service Center, a teletype tape and order set are received on a tape reperferator and teletype machine. This order set includes a multilith mat from which a work book is produced for actual production of the order. The balance of the order set is used for mill schedule copies, mill follow-up copies and shipping copies. The tape is attached to the shipping copies. At the time of shipment the tape is processed through a teletype processing unit. By keyboard teletype and teletype printer combined as one unit, all shipping notices are automatically produced at one time. Also included in the shipping set is a multilith mat from which all invoice copies are reproduced. There is also a multilith mat from which copies of test certificates are reproduced if needed. Approximately 70% of the information is typed from the tape; the balance is manually typed.

* * *

As you can readily see, all documents and teletype tapes at all points are automatically reproduced from a teletype tape originated in the District Sales Office. The routing of these orders to the different points in the system is handled automatically by a Central Control Switching Center in Cleveland. Each order is coded with a designated code for each point in the system and is sent to the Central Control Switching Center in Cleveland where it is automatically routed to the point coded. Also all teletype messages automatically routed through the Central Control Switching Center in Cleveland, are handled on these same lines.

* * *

On previous order entry systems, it has sometimes taken from seven to fourteen days for entry of orders. With the present system, it takes an average of one to two

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days. The savings of time for an average entry of an order is important, but of even greater importance is the fact that if the need arises, an order can be entered in a matter of hours. In addition to the savings of time, these facilities reduce the possibility of error in order entry and have eliminated many check points and postings. In addition to the advantages of order entry and invoicing, the availability of this teletype tape offers many possibilities as a source of infomation for tabulating procedures. By processing this teletype tape through a tape to card tabulating machine, punched cards for order entry and shipping information can be automatically reproduced.

* * *

This installation is one of the most up to date order entry systems in the steel industry today.

## Wire Insulation of "Teflon"® FEP—Fluorocarbon Resin—Properties and Fabrication

(*Continued from page* 1195)

constructions of FEP resin are shipboard cable, ground control cable, power cable, industrial control cable, and oil well cable or any other installation where weather resistance, chemical resistance, heat resistance and unusual reliability are required.

* * *

To summarize, "Teflon" FEP-fluorocarbon resin is a new melt-processable material which is processed rapidly and efficiently by conventional processing equipment. It has an outstanding combination of properties similar to those of the TFE resin. It is available at present in developmental quantities for evaluation and testing in the wire and cable field and will be commercially available in late 1959.


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## Accelerated Aging Tests In Service Performance of Neoprene Jacketed Drop Wire

(*Continued from page* 1179)

gradation as can be seen in Figure 2. For comparison, the alteration in the surface of a sample exposed 15 years in Atlantic City is shown in Fig. 3. It appears that the de-

Fig. 3—Neoprene Jacket Exposed 15 years in New Jersey

grading action is slower in Atlantic City. In both cases, however, the wire could be expected to serve satisfactorily for several more years.

★ ★ ★

**Because** of the low original elongation of the Formula I jacket, Formula II containing clay and less black was substituted and it has been used on the bulk of the production of neoprene jacketed drop wire. Table VI shows results of

TABLE VI
Aging of New Drop Wire Jacket
Miami, Fla.

| Duration of Exposure | Tensile Strength (psi) | Per cent Elongation | Per cent of Original Elongation |
|---|---|---|---|
| 0 | 2435 | 350 | 100 |
| 1 year 1 month | 2480 | 270 | 77 |
| 2 2 | 2440 | 270 | 77 |
| 7 1 | 2130 | 110 | 31 |

aging for 7 years in Miami and Table VII shows results of 12 years

TABLE VII
Aging of New Drop Wire Jacket
Los Angeles, Cal.

| Duration of Exposure | Tensile Strength (psi) | Per cent Elongation | Per cent of Original Elongation |
|---|---|---|---|
| 0 | 2695 | 440 | 100 |
| 1 year 6 months | 2790 | 315 | 71 |
| 9 years | 2425 | 220 | 50 |
| 12 years | 2600 | 180 | 41 |

aging in Los Angeles. In all cases no evidence of surface deterioration has been found in jackets of this newer formulation even under magnification.

★ ★ ★

**In** Fig. 4, per cent of elongation retained on the New Jersey, Florida and California samples is spotted on the aging curve developed in 1950. Positions of the New Jersey and California spots indicate that the prediction of service life in the order of twenty years is conservative. On the basis

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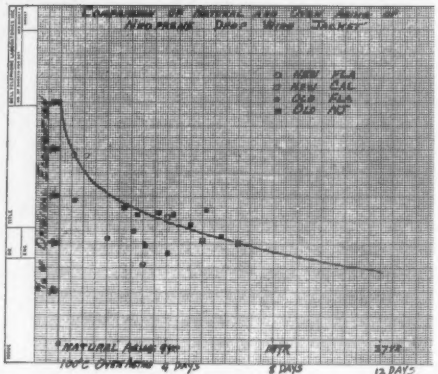

Fig. #4

of the results obtained on the new jacket in California and the old jacket in Florida, the result obtained on the new jacket exposed seven years in Florida appears questionable. However, even this result indicates that the wire would give satisfactory servce for the predicted period of 20 years.

★ ★ ★

**Field** personnel have been alerted to watch for evidence of ozone cracking especially in the Los Angeles area where this type of attack is severe. To date, no evidence of cracking of neoprene jacket has been reported. Some of the drops in this area are 13 years old.

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## The Manufacture of Welded Wire Mesh and Some of Its Uses

(*Continued from page* 1170)

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## The Thermal Embrittlement of Stressed Polyethylene

(*Continued from page* 1187)


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## Inclined Enameling Machines for Coating Fine Gage Wire

(*Continued from page* 1175)

tions of the roll in line with a baking channel carry a plurality of closely spaced 90° V grooves. It is these grooves that bring enamel from the supply trough to the wire. Groove depth varies from .002" to .030" but on any one roll, all grooves are the same depth. One roll may be used over a range of three to four wire sizes. The applicator assembly is constructed so that the roll can be stopped and completely submerged in circulating enamel when the machine is shut down, say for a weekend. This feature prevents excessive aeration of the enamel and prevents a skin from forming on the roll.

★ ★ ★

**Each** enameling machine has a small tank of about six gallons capacity, a pump and a single unit honeycomb filter. The overflow from the applicator returns to the tank and is recirculated through the filter and back to the applicator at a rate of about six gallons per hour.

### 5. Fume Disposal

**Enameling** fumes discharge from the baking tubes at the applicator end of the oven. The collecting duct or hood is located directly below the tube openings as is shown in Figure 8. The enamel fumes and a certain amount of room air are drawn into the hood and then discharged to the outside atmosphere through a large exhaust fan and metal duct system. One exhaust fan is used for 16 enameling ovens. With the exhaust hood located below the tubes, we avoid condensate dripping on the wire or building up across the tube openings to cause wire breaks. Drip pockets are provided at various points in the duct system for collection of condensate. These pockets are fitted with paper containers which are removed and discarded when they become filled with condensate.

### 6. Operation

**Wire** speed and roll groove size are specified in the operating instructions. These vary, of course,

with the size of wire being insulated. Oven temperature setting, roll speed and powerstat setting for the take-up motors are also specified but only approximately with such deviations as might be required to secure optimum bake and correct film thickness being left up to the "layout" operator. Some deviations are necessary because of differences between machines. Others are necessary to compensate for the effect of changes in room temperature. Our enameling room is not air conditioned and significant changes in room temperature sometimes occur usually from day to night, especially during very hot or very cold weather. These temperature changes affect enamel viscosity which in itself is not controlled at the machine and require adjustments in roll speed to keep enamel film thickness within limits.

★ ★ ★

**Head** assignment per operator varies from 96 to 144 depending on wire gage and size of take-up spool. Operators are concerned only with changing spools (both take-up and supply) making distributor adjustments to secure level winding, repairing wire breaks and adding fresh enamel to the machines.

★ ★ ★

**There** is a "layout" or chief operator for every 25 to 30 machines who "sets up" the machines for whatever wire size is to be run, makes oven temperature and roll speed adjustments and "rods out" the baking tubes should they become fouled up with condensate or fragments of wire. In addition to the above, there are two material handlers per shift who bring in supply wire and empty take-up spools and take away the spools of enameled wire and empty supply wire spools.

★ ★ ★

**Except** for a small amount of resistance wire, our bare wire supply is copper, hard drawn all the way from rod with no intermediate anneal. The heat of the baking operation is sufficient to anneal the hard wire as it is being enameled.

★ ★ ★

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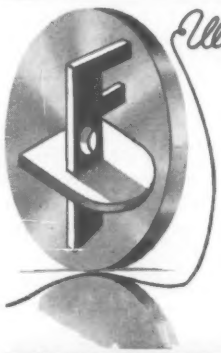

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uous (7 day 3 shift) operation but are shut down at intervals of from 12 to 16 weeks for a general cleaning. This is done on a rotation basis so that not more than two machines are down at one time for this purpose. Down time for cleaning is about eight hours.

## Lead Patenting of High Carbon Steel Rod and Wire

(*Continued from page* 1177)

**The** next step in the study was to run large quantities of rod under a condition of a fixed quench lead temperature. From the initial study, a temperature of 1025°F was selected. So called "rip" heats of rod were used in the second phase of this study. In the production of fine wire sizes, rod is patented, drawn to an intermediate size, patented again to restore ductility together with the proper tensile strength and then drawn to final size. Since the conditions of initial patenting of rip heats are not critical in regard to the final product, it was possible to run such heats under normal production conditions without disturbing mill routine. 157 heats of rod were run to secure the necessary data on possible tensile strength variations at a single quench lead temperature.

★ ★ ★

**Figure** No. 4 shows the increase in average tensile strength with increase in carbon content for the range of steels studied. While the average curve showed good correlation, individual values from heat to heat of any single type of steel varied too greatly. For example, all heats in the range of 0.65%-0.70% carbon, with normal ranges in manganese and silicon content showed a standard deviation from the average curve of 4200 p.s.i. which is equivalent to a spread of 25,000 p.s.i. between an individual maximum of one heat and an individual minimum of another heat.

★ ★ ★

**Heats** that deviate too far from an expected tensile strength are not desirable in the scheme of a close coupled rod mill and wire mill. Such variation in strength can only be accommodated by stockpiling large quantities of patented rod and scheduling from the stockpile. Since a high carbon specialty wire mill must normally work with a broad range of steels, stockpiling of patented rod can be a burdensome and costly operation. Stockpiling of billets prior to rod rolling is much more feasible provided that a heat which is selected for rolling against a certain wire order will produce the proper patenting strength.

★ ★ ★

**Since** patenting to a constant temperature did not produce sufficient consistency in tensile strength in the experimental heats and since the method of patenting then in operation produced too great extremes in lead temperature adjustments, the problem was approached from the viewpoint of patenting to a constant strength for any one type of steel. If the curve of Figure No. 4 is considered representative of the natural average tensile strength for any one type of steel, those heats of the same type which deviated from this average strength

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Range of Sizes:
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3½" long with 2⅛" head diam.

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could be brought down to or up to the average strength by a relatively small adjustment in quench lead temperature. Whereas usual quench lead adjustments normally covered a range of 150°F over a series of heats, patenting to a constant strength could cut the adjustment range to approximately 75°F or less.

★ ★ ★

The data of Figure No. 4 was accordingly used to establish a suitable constant strength value for each type of steel based on carbon content only. Since it would be impractical to use carbon increments as small as 0.01%, appropriate working ranges of carbon content were established and each range was assigned a constant strength using the nominal carbon content of the range as the identification figure for the strength. The strength corresponding to a carbon identification figure was the same regardless of other chemical elements and regardless of whether the material was heavy rod, light rod, heavy wire or fine wire.

It was stated earlier that this study was made on 3/16" rod at a constant quench lead temperature of 1025°F to determine desirable microstructures and correlated strengths. A 3/16" rod is the smallest size rod rolled at Roebling. It was also stated that lead patenting is not strictly an isothermal transformation. Because of the mass effect of various rod and wire sizes, it was not expected that an approximate average quench lead temperature of 1025°F would produce a constant strength for the entire range of rod and wire sizes involved. Practical application of the constant strength lead patenting plan showed that heavy rod sizes—11/32", 5/16", 9/32"—required a quench lead range of 975°F—1050°F; lighter rod sizes—1/4", 7/32", 3/16"—and wire sizes down to .165" required a quench lead range of 1000°F—1075°F and the smaller wire sizes down to .041" required a quench lead range of 1075°F—1140°F to produce a constant strength for any one type of steel. Since each patenting furnace handles a certain range of rod or wire sizes, the entire spread of quench lead temperatures would not apply to a single furnace.

★ ★ ★

The constant strength method of lead patenting was adopted as a standard manufacturing practice by the steel wire mill with the result that:

1. All carbon steel rod and wire, having the same nominal carbon content, is lead patented to a constant strength proper for the carbon content regardless of size as rod or wire and regardless of chemical elements other than carbon.
2. The patented microstructure is practically constant.
3. Quench lead temperature adjustments in patenting are small from heat to heat.
4. Gain in strength due to wire drawing is more consistent for any one type of carbon steel.
5. Variations in properties of the finished product are narrowed.

## New Catalog on Carbide Tools

A new catalog with information about Carboloy cemented carbide cutting tool materials and a new

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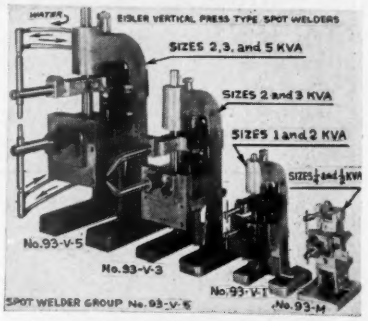


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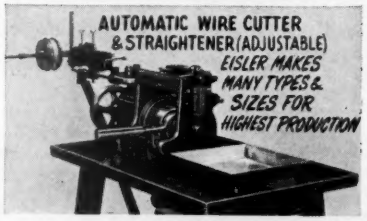


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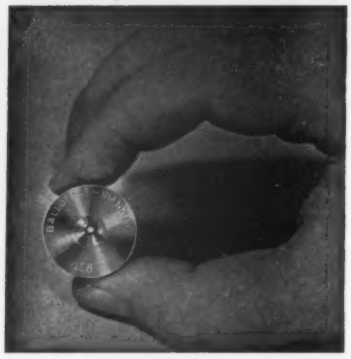

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pricing system for them is now available from the **Metallurgical Products Department** of **General Electric Company**, Detroit.

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**Listed** in the catalog are both positive and negative rake toolholders, Carboloy cemented carbide tools, tool bits and inserts. There also is a new technical and application data section on Carboloy cemented carbides.

* * *

**The** new pricing system, the Metallurgical Products Department said, will better reflect the changes taking place in its costs. As a result, prices on some items will be reduced significantly, while on others they will be increased.

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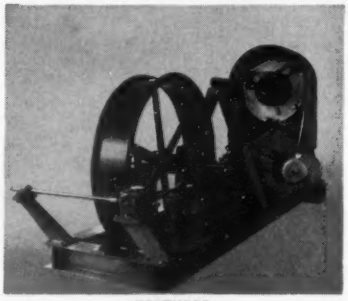

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## Chase Brass Promotes Salesman

**Promotion** of **Frank J. Anderson** from outside salesman to district manager of the **Chase Brass & Copper Co.** office in Seattle, Wash., effective Oct. 1, 1958, was made known by General Sales Manager **Walter E. Evans.** At the same time, the retirement of **Melvin A. Pugh** as district manager there, after 36 years service with Chase, was also announced.

★ ★ ★

A graduate of Fordham University, 1938, Mr. Anderson started work at Chase as a mill employee in Waterbury in 1943 and was a section foreman in the Tube Mill when, in 1945, he joined the Chase sales force as an inside salesman in their Los Angeles office. Two years later he was promoted to outside salesman at Seattle, the position he has held ever since.

## Oakite Promotes Seib and Steif

**George M. Seib,** formerly secretary of **Oakite Products, Inc.,** has been appointed vice president of the company, which manufactures industrial cleaning and metal treating compounds. **Erwin H. Steif,** who was Mr. Seib's assistant, has been promoted to the post of secretary.

★ ★ ★

**With** Oakite since 1922, Mr. Seib has been a member of the board of directors since 1946, and has served as secretary since 1953. Mr. Steif, a graduate of Yale Law School, joined Oakite in 1948 as legal counsel, and has served on the board of directors since 1953.

## Page Gets New General Manager

**Joseph N. Kemple** has been advanced to the position of General Manager, **Page Steel & Wire Division, American Chain & Cable Company, Inc.,** Monessen, Pa., according to an announcement by **C. N. Johns,** President. He assumed his new duties, effective September 15, after setting a fine record as the Division's sales manager from March 31, 1957 to the present.

★ ★ ★

A graduate of Stanford University, Palo Alto, Calif., class of 1947, with a B.S. and M.S. in Industrial Engineering, Mr. Kemple joined Page Steel & Wire after resigning as Manager, Wire Rope and Electrical Wire Sales, Columbia-Geneva Steel Division, United States Steel Corp., San Francisco, Calif.

## Union Spring Appoints Sales Executive

**W. F. McCabe,** President of **Union Spring and Manufacturing Company,** New Kensington, Pa., has announced the appointment of **Eric Eckberg** as Vice President in Charge of Sales.

★ ★ ★

**Before** his appointment at Union Spring, he held various engineering and sales posts with American Steel Foundries, American Fort Pitt Spring Division, H. K. Porter Co., Continental Can Co., and The William D. Gibson Spring Co. He is a graduate of Illinois Institute of Technology.

## Roebling Sales Appointments

**The** Wire Rope Division of **John A. Roebling's Sons Corp.,** has announced two sales appointments.

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.008"s to .102"
For many years . . .
Outstanding in quality,
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Drawing Angle-Controlled
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mounted unmounted
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Experts in Fine Size Diamond Dies
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1" to 60" Diameters
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**Robert J. Gregoire,** who has been associated with the logging industry in Idaho, will represent the company in northern California, working under the direction of **George C. Bukowsley,** San Francisco Division Manager.

★ ★ ★

**Lester F. Kreske,** with Roebling since 1947 in the Denver and Chicago office, has been made Chicago area sales representative for the company.

## Self Braking Dispensing Reel

**Mounted** on ball bearings, the newly developed "Copro Dispensing Reel" is equipped with a combination material guide and automatic braking device to assure smooth, orderly feeding of material from the reel to industrial sewing machines, cut-off machines, etc., providing instantaneous braking action to prevent uncontrolled uncoiling which often results with previously designed units, in considerable lost production time while machine operators untangle and re-coil spilled material.

★ ★ ★

**Constructed** of seamless tubing, fibre and spun aluminum, the reel assemblies wheel freely on ball bearings and are equipped with convenient clamps for quick, easy installation on or alongside the machine they feed. This simple, fast clamping construction allows the reel to be quickly moved from one machine to another, whereas previously designed reels in current use have been permanently positioned in location, thus preventing flexibility of usage.

★ ★ ★

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★ ★ ★

**The** Reel is designed and manufactured by **Company Products, Inc.,** 27700 Hoover Road, Center Line, Mich., Dept. 122-WW. A descriptive circular is available upon request.

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Wood, Plywood, Hardboard
8" to 72" in diameter
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1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Richard E. Brown, 453 Main Street, Stamford, Conn.; editor, Edmund D. Sickels, 453 Main Street, Stamford, Conn.; managing editor, none; business manager, Ruth S. Spengel, 453 Main Street, Stamford, Conn.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) Quinn-Brown Publishing Corporation, 453 Main Street, Stamford, Conn.; Richard E. Brown, 453 Main Street, Stamford, Conn.; Leta B. Brown, 1045 Summit Road, Montecito, Cal.; Ruth S. Spengel, 453 Main Street, Stamford, Conn.

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semi-weekly, and triweekly newspapers only.)

RUTH S. SPENGEL
Treas. & Business Manager

Sworn to and subscribed before me this 16th day of September, 1958.

HAZEL R. RANDLETT
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13. 1 11" x 14" Reel Haskell Dawes Twin Buncher.
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Machine Co., 21 Munro St.
Winsted, Conn.

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U. S. Manufacturers of *steel wire ropes* who are interested in extending their business possibilities to the European Common Market will find cooperation with a West German manufacturer of steel wire ropes.

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POSITION WANTED
OCCUPATION: Presently employed as Die-maker, 16 years experience in diamond and carbide die-making. Would like position with company desiring to improve die-room efficiency.
EXPERIENCE: Trained in all phases of die making. Offers ability, skill, instruction and supervisory capacities. References.
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24" 7 Bobbin Strander 1000# spool capacity. Full load running capacity of strander 600 to 700 RPM. Air operated brakes. Must be able to run core wire from rear of machine. Strander must have variable speed controls.

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453 Main Street Stamford, Conn.

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Wayne Wire Die Co., Hillside, N. J.

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Brenon, Inc., Nixon, N. J.
Ft. Wayne Wire Die Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
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Indiana Wire Die Company, Fort Wayne, Indiana
National Wire Die Co., Inc., New York, N. Y.

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Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

## DIES—Eyelet
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.

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Pittsburgh Carbide Die Co., Monongahela, Pa.

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Siggren Tool and Machine Co., Auburn, Mass.

## DIES—Polishing, Asbestos Wire
Beard Machine Co., York, Pa.

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Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.

Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.

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Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.

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**DIES—Tinning**
Roux Wire Die Works, Inc., Oriskany, N. Y.

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Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Hoosier Wire Die., Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

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(See MACHINERY—Draw Benches)

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Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

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Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

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Michigan Oven Company, Detroit, Mich.

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Platt Bros. & Co., The, Waterbury, Conn.

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Wilson, Lee, Engr. Co., Cleveland, Ohio

**FURNACES—Pot (Oil, Gas, Electric)**
Ajax Electric Company, Philadelphia, Pa.
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.

**FURNACES—Resistance Heating, Strand**
Electric Furnace Company, Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.

**FURNACES—Salt Bath**
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio

**FURNACES—Strand Annealing**
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Company, Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.

**GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)**

**GEARMOTORS—**
The Louis Allis Company, Milwaukee, Wisc.

**GRINDERS—Roll**
Norton Co., The, Worcester, Mass.

**GUIDES—For Wire**
Burlington Fabricators Inc., Products Div., Burlington, N. J.
Heany Industrial Ceramic Corp., New Haven, Conn.

**GUIDE TIPS—For Extruding Machines (See NOZZLES)**

**HAMMERS—Nail Heading**
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

**HAMMERS—Swaging**
Sjogren Tool and Machine Co., Auburn, Mass.

**HOISTS—Electric Travelling**
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

**INHIBITORS—Pickling**
Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

**INKS—Printing, for Insulated Wire**
Chemical Products Corporation, East Providence, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

**INSULATING MATERIALS —**
Apex Tire & Rubber Co., Pawtucket, R. I.
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
duPont de Nemours Co., (Inc.), E. I., Polychemical Dept., Wilmington, Delaware
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Shawinigan Resins Corporation, Springfield, Mass.
Thompson Chemical Company, Pawtucket, R. I.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

**LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire**

**LAME—LAHN—**
Montgomery Co., The, Windsor Locks, Conn.

**LIME—**
Warner Co., The, Philadelphia and Bellefonte, Pa.

**LUBRICANTS—For Metal Cutting, Stamping and Drawing**
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

**LUBRICANTS—Wire Drawing**
(See Compounds—Wire Drawing)

**LUBRICANTS—Wire Rope**
Swift & Co., Chicago, Ill.

**MACHINERY—Armoring (Cable, Wire, Hose)**
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

**MACHINERY—Barbed Wire**
Glader Wm., Machine Works, Chicago, Ill.

**MACHINERY—Bobbin Winders**
Hanson & Edwards, Ltd., Warrington, England
Larmuth and Bulmer, Limited, Manchester, England

**MACHINERY—Bolt, Rivet, Screw, etc.**
Behr Machinery & Equipment Corp., Rockford, Ill.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Braiding**
New England Butt Co., Providence, R. I., Division of Wanskuck Co.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Bunching**
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Bundling, Scrap**
Vaughn Machinery Co., Cuyahoga Falls, O.

**MACHINERY—Cable, Electric**
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)**

**MACHINERY—Centerless Grinding & Polishing**
American Laubscher Corporation, New York, N. Y.

**MACHINERY—Chain Link Fence**
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Steel & Wire Machinery Co., Cleveland, Ohio

**MACHINERY—Chain Making**
Baird Machine Company, Stratford, Conn.
Larmuth and Bulmer, Limited, Manchester, England
Nilson, A. H. Machine Co., Shelton, Conn.
Steel & Wire Machinery Co., Cleveland, Ohio

**MACHINERY—Closing Rope**
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

**MACHINERY—Coiling Rod**
Vaughn Mach'y Co., Cuyahoga Falls O.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Cold Heading**
Behr Machinery & Equipment Corp., Rockford, Ill.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Copper Wire Drawing**
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn, Maschinenfabrik, Herborn, Germany
Morgardshammars Mek Verkstads A. B., Morgardshammar, Sweden.
National Mach'y Exch (Used), New York
Steel & Wire Machinery Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)**

**MACHINERY—Cutting**
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.

**MACHINERY—Dead Block (Stationary Coiler)**
Morgan Construction Company, Worcester, Mass.
Wells Company, Frank L., Kenosha, Wisc.
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Descaling Rod, Dry**
Fisher Associates, New York, N. Y.
Herborn, Maschinenfabrik, Herborn, Germany

**MACHINERY—Die Making**
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
Metallurgical Products Dept. of General Electric Co., Detroit
Wayne Wire Die Co., Hillside, N. J.

**MACHINERY—Draw Benches**
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

**MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)**

**MACHINERY—Enameling**
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Co., Wallingford, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

**MACHINERY—Extruding**
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Royle, John, & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I

**MACHINERY—Fence**
Glader, Wm., Machine Works, Chicago, Ill.
Norton & Co., Ltd., Sir James Farmer, Manchester, England

**MACHINERY—Flat Wire**
Mettler Machine Tool, Inc., New Haven, Conn.
Steel Equipment Company, Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.

# WHERE TO BUY, Continued

## MACHINERY—Forming Wire
Baird Machine Company, Stratford, Conn.
Nilson, A. H. Machine Co., Shelton, Conn.
Steel & Wire Machinery Co., Cleveland, Ohio

## MACHINERY—Galvanizing Wire
Steel & Wire Machinery Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, O.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wilson, Lee, Engr. Co., Cleveland, Ohio

## MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Mfg. Co., Wallingford, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

## MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

## MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Beard Machine Co., York, Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

## MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia
Cook Mfg. Co., The, Paterson, N. J.
Michigan Oven Company, Detroit, Mich.

## MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

## MACHINERY—Material Handling
(See Material Handling Equipment)

## MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

## MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.

## MACHINERY—Packaging Wire
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

## MACHINERY—Patenting Wire
Whitacre Engineering & Manufacturing Company, Alhambra, California

## MACHINERY—Plating
Bartell Machine Tool Corp., Rome, N. Y.
Hodge Bros. Machine Shop, Ossining, N. Y.
Universal Industrial Equipment Co., Secaucus, N. J.

## MACHINERY—Pointing
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York,
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

## MACHINERY—Polishing Asbestos Wire
Beard Machine Co., York, Pa.

## MACHINERY—Printing on Electric Wire
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M. Co., Inc., Boylston, Mass.

## MACHINERY—Re-Spooling
Bartell Machine Tool Corp., Rome, N. Y.
Burlington Fabricators, Inc., Products Div., Burlington, N. J.
Colbourne Machine Company, Winsted, Conn.
Emory Company, Robert J., Newark, N. J.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
National Mach'y Exch. (Used), New York N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

## MACHINERY—Rod Mill
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.

## MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

## MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

## MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

## MACHINERY—Slitting Mills
Steel Equipment Company, Cleveland, Ohio

## MACHINERY—Spark Testing
Davis Electric Co., Wallingford, Conn.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

## MACHINERY—Spooling Tension Controls
Web Controls Corp., West Englewood, N. J.

## MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells Company, Frank L., Kenosha, Wisc.

## MACHINERY—Staple
Baird Machine Company, Stratford, Conn.
Nilson, A. H. Machine Co., Shelton, Conn.

## MACHINERY—Straightening & Cutting
American Laubscher Corporation, New York 19, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel & Wire Machinery Co., Cleveland, Ohio
Wells Company, Frank L., Kenosha, Wisc.

## MACHINERY—Stranding
Bartell Machine Tool Corp., Rome, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth & Bulmer Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Düsseldorf-Rath, Germany
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

## MACHINERY—Swaging
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

## MACHINERY—Take-Up and Pay-Out
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine Tool Corp., Rome, N. Y.
Burlington Fabricators, Inc., Products Div., Burlington, N. J.
Colbourne Machine Company, Winsted, Conn.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Kraft, J. A., Maschinenfabrik, OLPE/Westf. Germany
Larmuth & Bulmer Limited, Manchester, England
Litzler, C. A., Co., Inc., Cleveland, Ohio
Northern Indiana Steel Supply Co., Inc., Michigan City, Indiana
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

## MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

## MACHINERY—Testing Magnet Wire Coatings for Pin Holes
Federal Mfg. Co., Wallingford, Conn.

## MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

## MACHINERY—Thread Rolling
Mettler Machine Tool, Inc., New Haven, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

## MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

## MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

## MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

## MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

## MACHINERY—Twinning
(See Mach.—Bunching)

## MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

## MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

## MACHINERY—Welded Wire Mesh
National Electric Welding Machines Co., Bay City, Michigan
Schlatter, Ltd., H. A., Zollikon/Zurich

## MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery —Welding Wire Fabrics)

## MACHINERY—Winding Wire
Burlington Fabricators, Inc., Products Div., Burlington, N. J.
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Entwistle, James L., Esmond, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Watson Machine Co., Paterson, N. J.

## MACHINERY—Wire Drawing
American Laubscher Corporation, New York 19, N. Y.
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.

Federal Mfg. Co., Wallingford, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Morgan Construction Co., Worcester, Mass.
Morgardshammars Mek Verkstads AB, Morgardshammar, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Wire and Machinery Co., Cleveland, Ohio
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wartenweiler, Emilio, Milan, Italy
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Wire Forming**
Baird Machine Company, Stratford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Nilson, A. H. Machine Co., Shelton, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Wire Rope**
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Wrapping with Paper**
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Company, Boston, Mass.

**MATERIAL HANDLING EQUIPMENT—**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**MOTORS—Electric, A.C. — D.C.**
The Louis Allis Company, Milwaukee, Wisc.

**NAIL TOOLING—Tungsten Carbide**
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

**NAILS—Wire**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

**NIPPERS—Wire Cutting**
Robinson, M. W. Co., Rockfall, Conn.

**NOZZLES—For Extruding Machines**
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

**OVENS—Cable Lacquering and Enameling**
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

**OVENS—Rod Bakers**
Carl Mayer Corp., The, Cleveland, Ohio

**OVENS—Welding Rod Coating**
Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

**PAILS—Packaging**
(See Drums—Wire Packaging)

**PAINT BONDING CHEMICALS—**
Amchem Products, Inc., Ambler, Pa.

**PAINTS—Heat Resisting**
Amchem Products, Inc., Ambler, Pa.

**PAPER—Creped Wrapping**
Ludlow Papers, Inc., Needham Heights, Mass.

**PAPER—For Coil Wrapping and Corrosion Prevention**
Ludlow Papers, Inc., Needham Heights, Mass.

**PAPER—Insulating**
Ludlow Papers, Inc., Needham Heights, Mass.
Twitchell, Inc., E. W., Philadelphia, Pa.

**PATENT—ATTORNEYS—**
Rommel, Allwine & Rommel, Washington, D. C.

**PAY-OUT SYSTEMS—**
(See MACHINERY—Take-Up & Pay-Out)

**PHOSPHATE COATING CHEMICALS**
(See COMPOUNDS—Phosphate Coating)

**PICKLING COMPOUNDS—**
See (Inhibitors—Pickling)

**PLASTICIZERS—**
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, St. Louis, Mo.

**PLASTICS—for Wire Insulation**
Apex Tire & Rubber Co., Pawtucket, R. I.
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
duPont de Nemours Co., (Inc.), E. I., Polychemical Dept., Wilmington, Delaware
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Shawinigan Resins Corporation, Springfield, Mass.
Thompson Chemical Company, Pawtucket, R. I.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

**PRINTING WHEELS—for Electric Wire**
Frank Daniels & Co., New York, N. Y.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., Inc., West Hanover, Mass.
Gillies, Duncan M. Co. Inc., Boylston, Mass.

**PULLERS AND GRIPS—For Wire**
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

**RACKS—Wire Storage**
Burlington Fabricators, Inc., Products Div., Burlington, N. J.
Jarke Manufacturing Co., Chicago, Illinois

**REEL AND TENSION STANDS—**
Burlington Fabricators, Inc., Products Div., Burlington, N. J.
Metuel Machine Tool, Inc., New Haven, Conn.
Northern Indiana Steel Supply Co., Inc., Michigan City, Indiana
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

**REEL CRUTCHES—**
Watson Machine Co., Paterson, N. J.

**REELS & SPOOLS—Aluminum Alloy**
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS & SPOOLS—Annealing and Stranding**
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

**REELS—Metal Bound**
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.

**REELS—Plywood**
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

**REELS & SPOOLS—Steel (All Types)**
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Evans, George, Corp., Moline, Ill.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
New York Engineering Corp., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS—Steel, for Rope and Cable**
Evans, George, Corp., Moline, Ill.
New York Engineering Corp., Yonkers, N. Y.

**REELS—Wire Mill**
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Boonton Molding Company, Boonton, N. J.
Bridge Mfg. Co., The, Hazardville, Conn.
Burlington Fabricators, Inc., Products Div., Burlington, N. J.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
Nilson, A. H. Machine Co., Shelton, Conn.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Richard-Stuart Manufacturing Corp., Phila., Pa.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS & SPOOLS—Wood**
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

**REFRACTORIES—High Temperature**
Norton Company, Worcester, Mass.

**ROD BAKERS—**
(See OVENS—Rod Bakers)

**RODS—Stainless Steel**
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Pittsburgh Steel Co., Pittsburgh, Pa.

**RODS—Wire—Non-Ferrous**
Aluminum Company of America, Pittsburgh, Pa.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.

**RODS—Steel**
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Niederrheinische Huette, A. G., Duisburg, Germany
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

**ROPE—Wire**
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.

**RUST PROOF COMPOUNDS—**
(See COMPOUNDS—RUST Preventing)

**RUST REMOVING COMPOUNDS—**
(See COMPOUNDS—RUST Preventing)

**SATURATION SYSTEMS—**
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

**SOAPS—Industrial and Wire Drawing**
(See COMPOUNDS—Wire Drawing)

**SPOOLS—Plastic**
Boonton Molding Company, Boonton, N. J.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.

**STAMPINGS—Steel**
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

**STOCK STORAGE SYSTEMS**
Jarke Manufacturing Co., Chicago, Illinois

**STRIP—Steel**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

**TABLES—Press Feeding**

**TANKS—Ceramic, for Galvanizing**
Ofenbau Fritz G.m.b.H., Hagen i.W., W. Germany.

**TANKS—Compound**
Watson Machine Co., Paterson, N. J.

**TESTERS—INSULATION**
(See MACHINERY—Spark Testers)

**TESTING EQUIPMENT**
(See MACHINERY Testing, Physical and Diameter Testing)

**TINSEL—Electric Conductor**
Montgomery Co., The, Windsor Locks, Conn.

**TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.**
(See TINSEL—Electric Conductor)

**TOOLS—Nail Machine**
Pittsburgh Carbide Die Co., Monongahela, Pa.

**TRAMRAIL SYSTEMS—**
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

# WHERE TO BUY, Continued

**TRANSMISSIONS—Variable speed (See Adjustable Speed Drives)**

**TRAVERSES & DRUMS—For Reels**
(See Drums & Traverses)

**TRAVERSE MECHANISMS—**
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Hodge Bros. Machine Shop, Ossining, N. Y.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**VARNISHES & LACQUERS—for Electric Wire**
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
Shawinigan Resins Corporation, Springfield, Mass.

**VULCANIZING PANS AND EQUIPMENT—**
American Insulating Mach'y Co., Phila, Pa.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

**WAXES—for Insulated Wire**
Cary Chemicals, Inc., New Brunswick, N. J.

**WELDERS—Spot and Butt and Welding Wire Fabrics**
Eisler Engineering Corp., Newark, N. J.
Micro Products Co., Chicago, Ill.
National Electric Welding Machines Co., Bay City, Michigan
H. A. Schlatter, Ltd., Zollikon-Zurich

**WHEELS—for Printing on Electric Wire**
Frank Daniels & Co., New York, N. Y.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M., Co. Inc., Boylston, Mass.

**WIRE—Aluminum**
Aluminum Company of America, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Ball**
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Barbed**
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

**WIRE—Brass and Bronze**
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Cadmium**
Stamford Processing Co., Peekskill, N. Y.

**WIRE—Cast**
Youngstown Sheet & Tube Co., Youngstown, O.

**WIRE—Clad and Plated**
Sylvania Electric Products Inc., Warren, Pennsylvania

**WIRE—Cold Heading**
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

**WIRE—Copper**
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.

**WIRE—For Electrical Conductors**
Aluminum Company of America, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Flat**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Montgomery Co., The, Windsor Locks, Conn.
National Standard Company, Niles, Mich.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Galvanized**
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
National Standard Company, Niles, Mich.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—High Carbon**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Manufacturers**
Aluminum Company of America, Pittsburgh, Pa.
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corporation, Pressed Steel Div., Cleveland, Ohio
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

**WIRE—Metalizing**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

**WIRE—Music**
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Worcester Wire Works Div., National-Standard Company, Worcester, Mass.

**WIRE—Needle**
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Nickel Alloy**
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Nickel Silver and Phosphor Bronze**
Malin & Co., The, Cleveland, Ohio
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Oil Tempered**
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Special Shapes**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Continental Steel Corp., Kokomo, Ind.
National Lock Washer Company, The, Newark, N. J.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Spring**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Roebling's John A., Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

**WIRE—Stainless Steel**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Firth Sterling, Inc., Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Steel—Also Coppered and Galvanized Steel**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

**WIRE—Straightening and Cutting**
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Zinc**
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

**WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.**

**WRAPPING PAPER—Creped**
(See PAPER—Creped Wrapping)

**YARN TESTERS—**
Scott Testers, Inc., Providence, R. I.

# The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE
AND MASTICATING MACHINERY MANUFACTURERS

WATSON

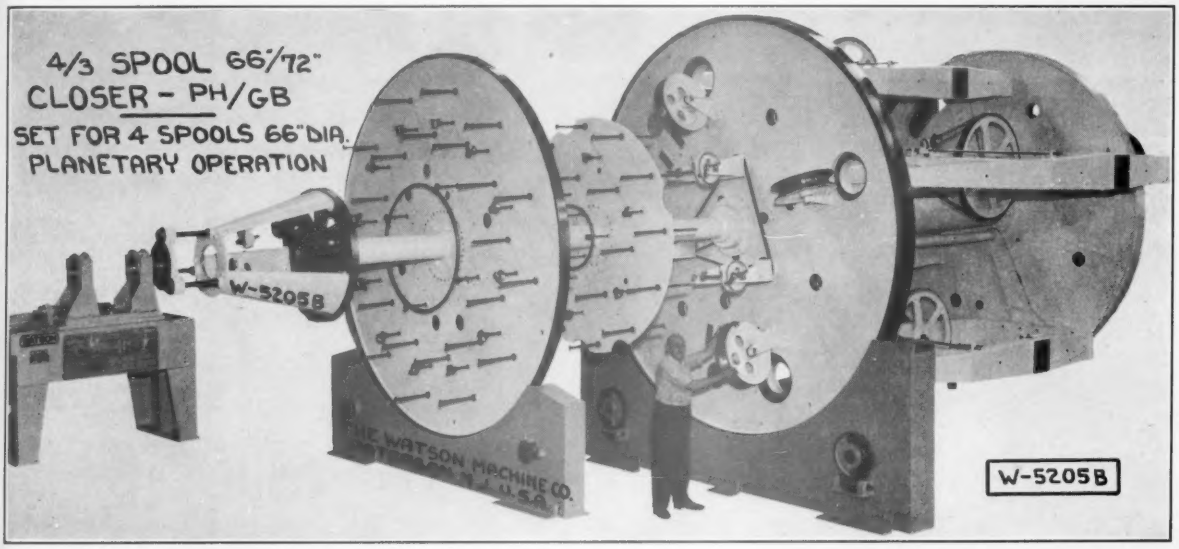
# 3 OR 4 SPOOL SECTOR CLOSER TYPE PH/GB

U. S. PATENT 2,270,093

**AMONG THE NOTEWORTHY ADVANTAGES AND DESIGN FEATURES OF THIS LATEST CONSTRUCTION ARE:**

**POSITION-SHIFT-MOVABLE "SHAFTLESS" CRADLES. THEY SWING FROM 90° TO 120° RADIAL SPACING FOR RAPID CONVERSION FROM 4- TO 3- SPOOL HEAD BY REMOVAL OF ONLY ONE CRADLE. AXIAL ROTATION OF EACH CRADLE TO ANY DESIRED POSITION BY LOCKABLE, MANUALLY OPERATED WORM AND WHEEL. CRADLES HAVE NO-LOOSE-PARTS, INTEGRAL FRICTIONS, AND THE PATENTED "SHAFTLESS" DESIGN ELIMINATES SPOOL "SIDE-SLAP" AND REDUCES LOADING TIME TO A MINIMUM.**

**GEARED BACKTURN, PLANETARY OR RIGID. BY RAPID HYDRAULIC "POP-OFF" REMOVAL OF ONE CHANGE GEAR PAIR, MACHINE CAN QUICKLY BE CHANGED FROM PLANETARY TO RIGID FRAME OPERATION OR VICE-VERSA. REPOSITIONING OF BUT A SINGLE GEAR REVERSES HEAD ROTATION. MAIN DRIVE IS FULLY HOUSED AND FORCE-FEED LUBRICATED.**




**CUT W-5205b (LEFT HAND ASSEMBLY) ALSO SHOWS, LOCKABLE WORM AND WHEEL MAIN SUPPORT ROLLER ADJUSTMENT, PLANETARY DRIVEN "SLING-SHOT" CRADLES FOR GAS TUBES, 84 FILLER COP SPINDLES AND INDEXED LAY HEAD.**

**THIS COMPLETE MACHINE IS 100 FEET LONG AND INCLUDES A TAPING SECTION, A 96" RING FLEETED SINGLE CAPSTAN, HYDRAULICALLY POWERED HEAD AND TAKEUP DRIVES AND A 96" SHAFTLESS TAKEUP.**

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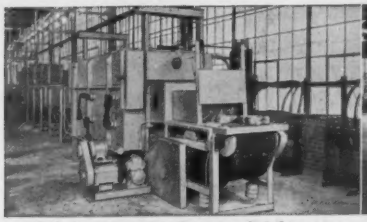
***ADDITIONAL DETAILS AND ILLUSTRATIONS UPON REQUEST.***

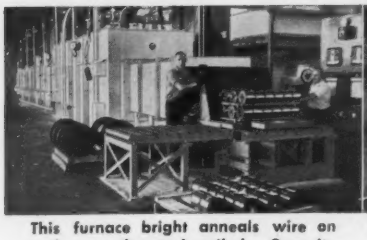
10-58



EF belt conveyor furnace bright annealing coiled alloy steel and non-ferrous wire.

EF continuous roller rail pusher furnace, bright anneals large reels and coils of wire.

# designed engineered and

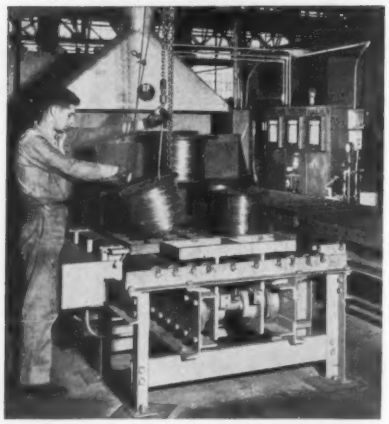


This furnace bright anneals wire on reels, spools, and coiled. Capacity 4000 lbs. per hr.

Stainless steel wire is bright annealed continuously in these EF multiple tube furnaces.

# Specially Built

## to meet the WIRE INDUSTRY'S requirements



Charging end of EF special atmosphere bulkhead pusher furnace; bright anneals copper and copperweld wire and clean anneals brass wire. Capacity 4000 lbs. per hr.

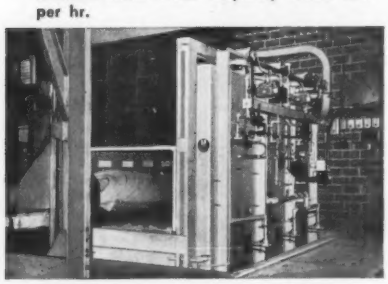
• We build production furnaces for heat processing all kinds of wire, rod, or other products — in any shape or form.

Years of practical experience in designing and building successful heat treating equipment for the wire industry enable us to furnish the best type of equipment for any purpose — and to produce the results required.

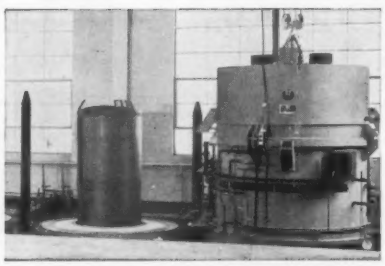
Shown here are 8 more production installations we made in prominent wire plants. We receive many repeat orders.

**Submit your production furnace problems to experienced EF engineers — it pays.**

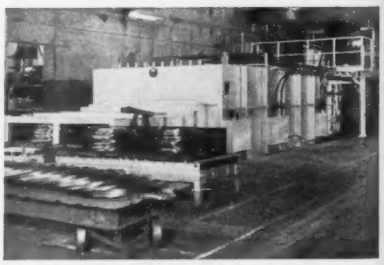
**THE ELECTRIC FURNACE CO.**
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS PRODUCT OR PRODUCTION
*Salem - Ohio*
Canadian Associates • CANEFCO LIMITED • Toronto 13, Canada



EF direct gas fired, single end, forced circulation hearth type annealing furnace with gantry crane for handling large coils of cupro nickel wire and brass rod.



EF direct gas fired bell type furnace with retorts and 4 forced circulation bases, used for bright annealing both ferrous and non-ferrous flat coiled wire.



EF special atmosphere continuous bright annealing furnace in which the wire is conveyed through the various zones on two parallel rows of bulkhead type trays.

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